Designing Effective User Onboarding Experiences for Mobile Applications

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Abstract

User onboarding is the process of increasing the likelihood that new users become successful when adopting your product, by providing them with the right tools to understand how a product works and what benefits it provides. The number of apps we daily manage on our mobile devices increases day by day, thus requiring a hard work by designers to create the best user onboarding experience ever. Since it represents the first interactive, direct experience that every user has of an app, every aspect of the funnel represents a significant opportunity for activation and retention of customers in the short- and long-term. In the wide landscape of mobile apps, brain training apps need to have an additional closer look at the onboarding experience they provide. For this type of apps, onboarding does not only encompass more common activities such as user registration and free trial activation, but also the possibility to develop an accurately personalized game experience, tailored to the user's current cognitive skills and training objectives. Elevate is a successful brain training app available on iOS and Android devices. Recent monitoring of users' retention and churn rates have shown a huge loss of customers during the onboarding process, thus generating the need to investigate on how to restructure the flow in a way that could help keeping more customers in the loop. The analysis of quantitative and qualitative data with respect to Elevate's key success metrics has led to a redesign of the welcome pitch, the user registration process, and the post-registration up-sell screen. It has also brought changes to the immediate post-onboarding experience of the first training session, and to the re-onboarding of churned users. A/B tests have been carried out to analyze the behavior of different variants and choose the optimal new onboarding flow. First results show expansion of the onboarding funnel, strengthening of the benefit appeal, and acceleration in user motivation, all factors leading to a higher customer activation and retention.

Keywords User onboarding, onboarding flow, adaptive games, personalized UX, pre-trial, app open, user retention, user churn, brain training app

Preface

After two years, two universities, and three countries, the journey of my master's degree comes to an end with this thesis. These two years have given me a lot from a professional and a human point of view, and I'm grateful to every single person that was part of my life and helped me achieve this result.

It has been amazing to work on this thesis topic at Elevate Labs with all the amazing people and smart professionals at the company. The Elevate team does a great job on an amazing product, while managing to create a great working relationship even in these months affected by a global pandemic. My manager Jeremy Levine and my advisor Antón Morant Fernández were always a constant support, but I also want to thank the other colleagues working in engineering, product, design, and QA on the Elevate team.

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And most importantly I want to thank my family, my friends, and my girlfriend Solène for being my moral support and source of joy and fun, but also for being there during six depressing months locked in a room on the other side of the world because of the pandemic. If I am still here, stronger than before, it is because of you all.

I cannot wait to publish this project and move on with my professional life at Elevate Labs, and I am sure that the experience I achieved in these two years will bring me to even more amazing results in the future.

Otaniemi, 28.9.2020

Antonio Chiappetta

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Symbols and abbreviations

Abbreviations

EPQ	Elevate Proficiency Quotient
GDD	Goal-Directed Design
HCD	Human-Centered Design
HCI	Human-Computer Interface
IoT	Internet of Things
MI	Minimalist Instruction
PD	Participatory Design
QA	Quality Assurance
SSO	Single Sign-On
UI	User Interface
UX	User eXperience

1 Introduction

User onboarding is the process of increasing the likelihood that new users become successful when adopting your product [1], by providing them with the right tools to understand how a product works and what benefits it provides.

The number of apps we daily manage on our mobile devices increases day by day, thus requiring a hard work by designers to create the best user onboarding experience ever. Since it represents the first interactive, direct experience that every user has of an app, every aspect of the funnel represents a significant opportunity for activation and retention of customers in the short- and long-term.

Among the main components of the onboarding process in mobile apps, most common ones include:

- Initial onboarding pitch - reinforcing the passive, indirect benefits people learned about in a pre-install phase (in ads, on the app store listing).
- Registration - the user is prompted to create an account with some personal information that are needed to perform the activities the app enables.
- Post-registration up-sell screen - the user is prompted to start a trial, or continue with a free, feature-limited account.
- Permissions authorization - the user agrees on providing access to sensitive features on its device or receiving push notifications.

In the wide landscape of mobile apps, brain training apps need to have an additional closer look at the onboarding experience they provide. For this type of apps, onboarding does not only encompass the common components described above, but some more specific ones, such as:

- Training goals - the user select which benefits they want to receive, representing a more active point in time where they report precisely what they want to get out of the app in the long term.
- Onboarding test - the user gets tested for their current level in all the cognitive skills practiced in the app and placed accordingly. The user gets a small taste of what they might learn and practice during everyday training sessions.
- Initial training session - the user is brought into their training session flow for the first time, with additional explanations they may not see in the future.

Elevate [2] is a successful brain training app available on iOS and Android devices. To enable users to get access to the certified mental fitness program offered [3], transmitting a memorable first impression during onboarding is fundamental. Every aspect of the funnel represents a significant opportunity.

Analysis on Elevate's data up to the first quarter of 2020 shows that roughly 65% of users make it from install to registration. There is a 25% drop-off rate for the registration screen, and another 25% drop-off rate on the post-registration up-sell

screen. Expanding the onboarding funnel can bring in more users and trial starts in the first place, and has the added user benefit of giving them a more seamless, cognitively pleasing experience.

Onboarding is where every user, regardless of their future activity, gets a first impression about the app. The pitch cards, training goals, and EPQ personalization tell the user what they are likely to go out of playing Elevate. Strengthening the benefit appeal of Elevate can result in higher subscription conversion, retention, and engagement activity.

Accelerating user motivation during onboarding through improvements to the onboarding test, the EPQ reveal, the staging of the free trial offer, training reminders, and the introduction to the first training session can help the user start their training on the right foot. It is reasonable to think this could show up in early training session engagement, overall day-one retention and session completion rates.

Major unknowns are related to how interconnected the onboarding is with the rest of the app experience, and how it relates to life changes in a user, thus requiring re-onboarding at various stages.

That said, the primary objectives of this thesis are:

- To understand which factors determine the best user onboarding flow for a mobile app.
- To determine how onboarding relates to life changes in a user and when re-onboarding is required at various stages.
- To determine how onboarding can be used to let users gain more trust and confidence in the apps, with greater transparency of what data the app collects and how it can be used.
- To determine how incremental onboarding can allow users a light touch of the platform before using it and becoming useful enough for a premium account.
- To understand positive and negative aspects of the onboarding flow in the most popular brain training mobile apps.
- To design and implement an optimal onboarding landing screen for a brain training app.
- To design and implement an optimal registration flow for a brain training app, possibly leveraging new Single Sign-On (SSO) solutions.
- To create the best flow to define training goals and assessing a user's current skill level.
- To define how to connect the onboarding experience to the initial training sessions and to the start of a free trial.
- To understand how the improvements generated by this work may impact user acquisition, retention, and churn.

The research questions can consequently be defined in this way:

RQ1. Which factors determine the best user onboarding flow for a mobile app?

RQ2. How does onboarding relate to life changes in a user? When is re-onboarding required at various stages?

RQ3. How can onboarding be used to let users gain more trust and confidence in the apps, with greater transparency of what data the app collects and how it can be used?

RQ4. How can incremental onboarding allow users a light touch of the platform before using it and becoming useful enough for a premium account?

RQ5. What are the positive and negative aspects of the onboarding flow in the most popular brain training mobile apps?

RQ6. How to design and implement an optimal onboarding landing screen for a brain training app?

RQ7. How to design and implement an optimal registration flow for a brain training app? How to leverage new Single Sign-On (SSO) solutions in this flow?

RQ8. How to create the best flow to define training goals and assess a user's current skill level?

RQ9. How to connect the onboarding experience to the initial training sessions and to the start of a free trial?

RQ10. What improvements can this work generate in terms of user acquisition, retention, and churn?

The work starts with a background analysis of literature in the field of UX onboarding in mobile apps, with a focus on what the most successful brain training apps do.

Research material about the current user onboarding flow in Elevate is then gathered through processes of quantitative user research on Elevate user base, and qualitative research on a sample of daily active users.

The synthesis of background analysis and user research is then used in the design of improvements to the initial landing screen, registration flow, up-sell screen, training reminders, training test and onboarding test, and post-registration behavior.

The implemented developments are described in terms of changes to the existing onboarding flow of the Elevate app.

Subsequently, A/B experiments are carried out to prove the efficacy of the proposed improvements on core actionable metrics.

In conclusion, results are presented with suggestions on future developments.

2 Background

2.1 Literature

2.1.1 Onboarding process

Designing a delightful and productive user experience in digital products is a good example of how the famous proverb stating that "well begun is half done" applies in real life. Soong et al. [4] claim that, in the web industry, a product has a unquestionably higher chance of engaging and retaining customers when providing ease of use and clarity in its value proposition at an early stage.

The idea of onboarding comes from the organizational world, where this term refers to the process new employees go through in order to achieve the knowledge, behavior, and skills needed to perform efficiently This same concept can be used with respect to software [5]. UX designer Samuel Hulick defines User Onboarding as the ”process of increasing the likelihood that new users become successful when adopting your product” [1].

According to Soong et al. [4], the primary goals of this process are two: one is the more utility-focused goal of helping new users to get started with the product interface; the other is the more value-focused goal of convincing new users that the product they are approaching provides exactly the value they were looking for. When onboarding well exposes the product's value to new users, they enter a habit look that makes them return, thus generating increased retention, which according to many most accurately measures the effectiveness of onboarding.

Strahm et al. [6] show that onboarding tasks such as instructional text, just-in-time hints, or interactive tutorials are commonly used in several applications to show new users the benefits of the application and create engagement with them. However, these onboarding decisions do not build on strong methodological or theoretical foundations. Industry professionals have tried to define guidelines, but usually these guidelines are formulated outside of the context of generative user research or design theory, and lack connection with the ways that users learn to adapt to new technological environments.

2.1.1.1 Elements of user onboarding

Task flows for user onboarding include didactic elements positioned in crucial points of the application, that unitedly work as a built-in tutorial for new users. Onboarding can have a relevance when users learn to use a new type of application, a supplementary application within a known and specific genre, or updated versions of a previously known application. Examples of onboarding design patterns include: instructional text, tours, progress bars, just-in-time hints, tips placed near user-generated content, and interactive tutorials [6]. The variety of tasks and contents to present during user onboarding depend upon various professional or academic perspectives, needed in order to perfectly deal with each aspect of the problem [7].

Renz et al. [8] states that the user onboarding flow can be divided in three successive stages: initial onboarding, help and support and re-engagement. But

according to Galavan [9] at Intercom, the onboarding does not have a final state, but it can rather continue endlessly. The more users explore an application, the more features they will discover. And for each of these new features, they will need to be onboarded.

Higgins [10] mentions three main onboarding principles:

- interactive and contextual instructions should be used to make the user learn while exploring;
- in an effort to create trust and positive feelings, the application should present to users a limited subset of its features before asking them to register an account;
- user needs and goals should be emphasized during onboarding through personalization and assistance to user tasks.

Strahm et al. [6] propose a design method based on Carroll's minimalist instruction framework [11], aiming at building design insights from onboarding through users' meaning-making processes. This technique employs an iterative array of design and evaluation activities, in which users participate in structured mini-interviews about a mediated interaction with a prototype of the product.

2.1.1.2 Value proposition

Intercom, a customer service company, states that onboarding is the only feature that each customer will use [12]. According to them, an effective onboarding starts with a story that shows the value of the product to make customers successful. Every potential customer is investing time when trying a new product, and wants to fulfill his expectations. The designer should consequently discern what makes the product a must-have and show it during onboarding.

Osterwalder [13] shows that value can be demonstration through the development of a value proposition, i.e., a promise to the customer of value to be delivered and benefits to be experienced. Advertise this message early is the key to successfully onboarding new users [5].

As Nielsen shows [14], users are very impatient online, they tend to leave a web page after 10-20 seconds and pay attention only to a few words that create interest or trigger a reaction in them. This makes it difficult for companies to capture their attention. Microsoft Research conducted a study [15] in which they analysed more than 2 billion dwell times, and leading to the conclusion that page visits follow a negative Weibull distribution: in short, they showed that the longer a user spends time on a page, the less likely he will decide to leave.

2.1.1.3 Learnability of applications

When a player enters a game for the first time, he needs to win a very demanding obstacle which ultimately will make up for their full perception of the game: learning how to play. Endresen [7] shows that the employment of incorrect instruction or

insufficient tutorial systems is the main issue causing the player to leave the game, because it deprives him of the possibility to interact successfully with it. The same argument can easily be applied to a mobile application.

Strahm et al. [6] analyze the development of learnability of applications through the last decades. During the 1980s, theories of application design and usability such as "training wheels" were applied in the design of computing systems to ensure that users would be able to successfully explore and use applications in a constructed way, with clear instructional aids and limited functionality to guide potential actions. Other academics have built upon learning or instructional theory in an effort to engage with different aspects of the learning process users undergo when using a new application. Yi and Davis [16] described the role of observational learning processes (attention, retention, production, and motivation) inside the process of skill acquisition that user go through in a software environment. Haramundanis [17] defined visual consistency and usability among the main drivers of learnability in information design. Lastly, Leutner [18] built on top of the "training wheels" approach, and increased user acquisition of application knowledge by creating "double fading" of support, through the conjunction of detailed guidance with limited application functionality.

Strahm et al. [6] also observe that the issue of learning through onboarding has been discussed in a short number of HCI publications, but always with respect to specific products, contexts, or learning outcomes, rather than being adapted towards a general technique to build successful onboarding experiences.

2.1.1.4 The "aha" moment

When trying to get answers about the effectiveness of an onboarding process, Hulick [1] theorizes that the perfect people able to answer these questions are those customers who recently became successful with the product. Professionals of "Jobs-to-be-done" describe this moment as the "switching moment" [19]. Lamothe says that users in this state should detail the moment when they realized the old product was not enough for them, and what was the reaction of people around them when they told about the change. On the other side, the study should focus on which motivations triggered the switch.

Agrawal [20] points that recently, with the increased popularity of the Growth Hacking mindset, people have been talking about the "aha moment" as that moment when the user makes the value provided by the product internal to himself, and thus the real goal of user onboarding. The key to make this moment successful is to make sure that new users perform those tasks that have previously proved to be synonym of long-term use. For Strahm et al. [6], the "aha moment" is a transformative and irreversible change in the way the user perceives the application, combining previously arbitrary facts and features into a mental model aiming at resolute and strong-willed use. In this moment, some complicated aspects of the relationship between the user and the product are resolved, since the mental construct creates connected knowledge among facts and features of the application.

2.1.1.5 Appeal to emotions

Hulick [1] discusses the importance of creating products able to appeal to the emotions of the users, and consequently able to react to the emotional response to convince them that your product offers a superior service compared to others. Underlining this differentiation with testimonies and recommendations from current customers has the advantage of highlighting these benefits without losing trust. Another interesting insight is that the usage of numbers can be a powerful technique to convince users, since it creates the feeling that other people are really using the product.

2.1.1.6 Sign-up process

In order to get users to sign-up to your service, Hulick describes the factors to avoid as Points of Friction and Points of Disconnect [1]. Points of Friction are confusing steps in the process, such as when a user asks himself the reason why certain sensitive information are needed to register to the service. Points of Disconnect are steps moving the user away from the creation of an account, such as the verification of the email address, that requires users to open another application before continuing the process. Once these points of friction and disconnect are removed, the sign-up should look like a conversation between the designer and the user.

2.1.1.7 Designing a first-run experience

The psychological theory called "Peak-End rule" states that humans value an experience by the most intense moment and by the way it ends. Hulick [1], in order to describe a first-run experience, rejects this approach and underlines again the importance of establishing a real-life conversation with the user. This conversation should be polite, as in a first meeting between two people: the user should be greeted, praised, and recommended during the first usage. The interface has to be self-evident, since users tend to fast-forward through the process, hungry to taste the real features of the product.

Once these steps achieve the peak, interest has to be preserved until the user successfully completes his day-one experience. As pointed out by Susan Weinschenk [21], progress bars and lists of to-dos can help creating the beloved feeling of achieving progress and completion, while completing useful tasks and exploring the product. Nunes et al. [22] proved the effectiveness of the "Endowed Progress Effect", i.e., that providing users with artificial advancement towards an objective generates greater persistence towards reaching the objective. In short this tells that not starting from zero can be a motivating factor to complete a list of tasks.

2.1.1.8 Data-driven optimization

At LinkedIn, Soong et al. [4] analyze the role of data-driven optimization in designing user onboarding.

Their starting point is that the increased prosperity of data-driven culture in major web companies are generating a consistent amount of literature from tech giants

that describes how they use data to inform their product strategies. Data-driven practices include in-depth studies of user behavior, identification of opportunities for product improvement, and online experimentation of new products and features to evaluate its impact on an Overall Evaluation Criteria.

But when it comes to the user onboarding, it is complicated to use data metrics to drive the personalization of this process, due to the lack of information about a new user.

The challenge is even greater if the focus of onboarding becomes long-term engagement. Retention is a lagged metric, so there is often a conflict between the time it takes to measure retention and the desire to iterate quickly which most web product teams treat as a mantra. Few web product teams would want to wait months to learn if a proposed change in the onboarding experience improves retention rate. Instead, they prefer metrics that can be observed in the short term, in response to a product change. Therefore, there is a need for metrics that are both sensitive to changes in the short term and correlated with better retention in the long term.

Future retention rates are a good tool to measure long-term engagement. Future retention periods are typically associated with retention in the previous periods. Choosing a retention period that is too far in the future makes it complicated to correlate the impact back to the first-day experience. On the other hand, choosing a retention period that is too close to the first-day experience will measure the impact to short-term retention rather than long-term retention.

Song et al. analyzed past user logs to show the relationship between some early signals and long-term retention. In order to fulfill the goal of informing a product strategy for user retention, they have built a predictive model that is interpretable and actionable, by filtering collected features from user onboarding that could be influenced by product. This led to the definition of Quality Signup (QS) as their true north-star metric for user onboarding, defined as: a new user who is reachable by other users, has made their first connection, and has filled out company or school information on their profile.

2.1.2 Mental models

2.1.2.1 Fogg Behavior Model

The Fogg Behavior Model in a mental model of user behavior developed by BJ Fogg, a researcher at the Persuasive Technology Lab at Stanford University [23]. Fogg describes the creation of systems able to change people's behavior by stating how a new behavior comes from the coexistence of triggers, motivation, and ability. A behavior can happen if and only if triggered exactly when the user has acquired enough motivation and ability.

Triggers can either be external or internal. The former are triggers inside the user's environment, such as word of mouth, notifications, and advertising, they constitute an influence from the outside telling the user what to do. The latter are instead connected with habits, thoughts, and emotions [24]. For both types, timing is fundamental.

According to the model, humans have three main motivations:

- pleasure, used to avoid pain;
- hope, used to avoid fear;
- social acceptance, used to avoid rejection;

The last factor considered in the model is ability, as in being able to execute an action. Fogg underlines that ability should not be confounded with exercise, given that users tend to be lazy and avoid unnecessary efforts. On the contrary, he uses as a synonym for ability the term "elements of simplicity", as simplicity constitutes a way to boost ability. Fogg discusses ability as comprising six components: brain cycles, money, non-routine, physical effort, social deviance, and time. Simplicity can only be achieved if all these components coexist. On these lines, Eyal [24] proposes a model leveraging simplicity to increase ability. He states that the first step to take should be understanding why a person needs to use a service. Therefore, all steps the user should perform to achieve his goal with the service should be detailed, and the unnecessary ones should be removed. In this way, the simplest possible process will be identified.

2.1.2.2 Building habits

Creating habits makes it easier for a product to resist market competition, since it becomes able to change the routine of its user. Eyal analyzes the formation of habits by defining the Hook Model [24]. He theorizes that the sequence of a trigger, an action, a variable reward, and an investment can create a new habit for the user. But, according to Gourville [25], offering a habit change is not easy, given that customers tend to overestimate the shortcomings generated by a new product compared to the benefits it may bring to his routine. Consequently, it is necessary to account for the resistance from users but also try to lessen the resistance of the product. This can only be achieved when talking both with people that love the product and with the ones that do not know it yet.

Duhigg [26] models habits as a "Habit Loop" of three phases. Each habit has a hint triggering the behavior, which then leads to a routine. Ultimately, a reward helps the brain to memorize the pattern for the future. Changing a habit means deciding ahead of time what action to perform when the trigger manifests and what will the final reward be.

2.1.2.3 Variable rewards

In the Hook Model defined by Eyal [24], variable rewards represent a way to honor the users' actions in order to keep them excited and motivated, so that they keep on using and returning to your product. These rewards can take three forms: the tribe, the hunt, and the self. During the development of habit-forming products, these three types of rewards need to be balanced.

Variable rewards of the tribe make the user feel accepted and included by people in his environment, generating a sense of connection. Rewards of the hunt originate from the primordial quest of humans for resources and information. Rewards of

the self correspond the personal satisfaction generated by mastery and success in completing tasks or overcoming obstacles. Ideas from the self-determination theory on human motivation [27], highlighting people's attitude to strive for autonomy and competence, can be integrated in the development of a new product, to generate rewards of the self. Eyal [24] shows how these practices are used in the domain of video games, where a sense of satisfaction and progress is generated by unlocking levels and badges.

Consequently, the combination of variable rewards motivating the user around his needs for social acceptation, information hunting, and personal satisfaction can help building products that the user will keep on using and revisiting.

2.1.2.4 Time investment

Norton et al. describe the power of the IKEA effect [28]. When a person invests his time to complete a set of tasks, he shows an affection with the achievement, thus leading to a stronger connection to it. This effect can be really powerful in the context of user onboarding. According to this model, making the user successfully complete a set of tasks during their first experience can result in a higher retention and affection to the product.

Eyal discusses the importance of making the user invest time in a product [24], in order to create knowledge about its benefits and confidence that he will become more successful by using it more. Gathering sensitive information from the user and social factors, such as followers and reputation in a community, are all factors that may lead the user to invest time and be committed to the product. When the user decides to invest enough time to develop a skill, he will gain a sense of mastery and ability. Connecting again to the Fogg Behavior Model [23], this will in turn increase the chance of developing a new behavior, and thus retaining the customer.

2.1.2.5 Progress

Carroll states that new users crave for quick and tangible progress towards their objectives [11]. Showing them their progress engages them early in the active learning process, and helps to balance the need for information with the need for experimenting and producing, thus giving a sense of confidence and control. Similarly to the "quick win" described by Hulick [1] for onboarding design, Van der Meij and Carroll [29] use this principle in the creation of a list of short-term objectives to reflect quickly changing user goals.

2.1.3 Brain training

Brain training encompasses the use of particular exercises, often games, to increase cognitive abilities [30]. Brain training products have a wide appeal, even though little peer-reviewed research proves the advertised neuroscientific efficacy of their exercises.

Brain training applications appeal consumers thanks to their accessible, affordable, and non-invasive cognitive interventions. Customers range from younger workers

looking for ways to be more productive, to older adults suffering from dementia and other psychiatric disorders.

2.1.3.1 Elevate

Elevate [2] is a successful brain training app available on iOS and Android devices. To enable users to get access to the certified mental fitness program offered [3], transmitting a memorable first impression during onboarding is fundamental. Every aspect of the funnel represents a significant opportunity.

2.1.3.2 Barriers and beliefs

Torous et al. gathered survey data [30] showing an increasing level of interest in brain training apps in the US, particularly among younger people. Positive perception of these apps is high both for app-naive and app-exposed participants, indicating how important user expectations are in prompting experience and usage of these apps. Little concern about sensitive data security and absence of medical endorsement indicates apps are not being used in medical settings. However, the audience's interest in the efficacy of these products suggests a shared theme with the concerns of the scientific community about the cognitive foundations of brain training.

2.1.3.3 Adaptive gamification in education

Mobile applications aiming at creating a educational context for their users, such as brain training applications, need to personalize the experience they offer to their needs and preferences. The challenge of adaptation needs of course to be tackled right from the onboarding of a user.

Škuta and Kostolányová [31] define as adaptive any kind of educational and learning environment that manages to observe and understand all actions performed by its users (the students), in order to infer user preferences. Once processed this information, it is able to dynamically adjust the learning process.

Bradáč and Kostolányová [32] describe the way teaching adapts to the user as:

- Adaptation of the user interface
- Adaptation of teaching content
- Adaptation of search and compilation of teaching content
- Adaptive support for cooperation

Škuta and Kostolányová [31] discussed the creation of an adaptive environment through gamification. Gamification consists of adding elements and principles that are typical of games into non-gaming environments and situations [33]. A game principle is how the user gets to the defined goal [34]. Common examples of game principles are:

- Freedom to fail

- Goals / Challenges
- Personalization
- Social engagement
- Storyline
- Time restriction
- Unlocking content
- Visible status
- Onboarding

A game element is a way of depicting progress, which may be partial or final [34]. Common examples of game elements are:

- Avatars
- Badges
- Leaderboards
- Levels
- Points
- Virtual goods

In order to design an abstract adaptive layer, the analysis provided by Škuta and Kostolányová [31] maps these principles and elements to the four basic categories for player's typology proposed by Richard Bartle [35]:

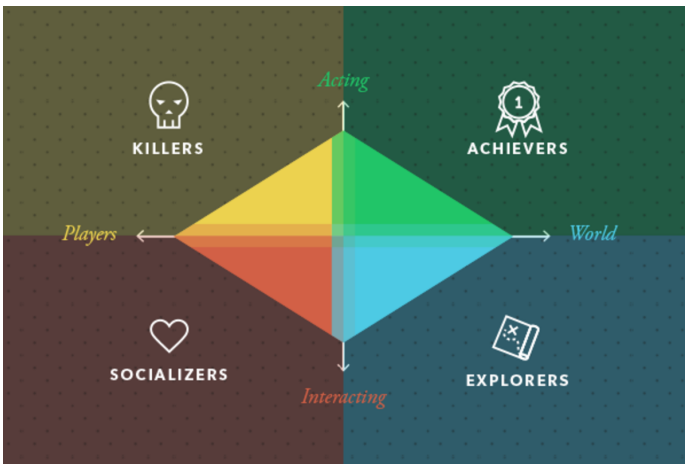


Figure 1: Player taxonomy

- Achiever - A player attracted by achievement and success

- Explorer - A player aimed at examining information and making discoveries inside the environment, going under the surface of things
- Socializer - A player focused on the interaction among players, preferring situations of co-operation and team-play
- Killer - A player attracted by killing and overcoming other players

The mapping presents an obvious partial overlap, caused by the general way in which principles and elements are described.

The proposed way to implement the game elements into the educational environment and adapt them is to use introductory tutorials in the form of a truncated demonstration in which all the game elements would be displayed by default and all the principles used.

2.2 State of the art

This section covers a taxonomy of best user onboarding solutions for mobile apps, starting from a broader perspective to later focus only on brain training apps. An additional section is dedicated to research projects.

2.2.1 Best onboarding UX in mobile apps

Recent blog posts such as [36] try to determine the best user onboarding experiences in the landscape of mobile apps.

2.2.1.1 12min

12min [37] aims at condensing learning from the best business and personal development books into short snippets that can be consumed at any moment and in any place. Their initial screen clearly states this value proposition with short statements and images.

Delighters in 12min's mobile app onboarding experience are [36]:

- Concise. All the information needed for new users are provided in a succint way, which is crucial in the digital world, where people dedicate only short portions of their time to a new product.
- Value-focused. Three key questions answered in chronological order: what, where, and how.
- Appealing. The aesthetic work on branding and UI pays off.
- Fast. A simple and quick onboarding process, which contributes to diminish the risk that users leave before completing it.

2.2.1.2 Brilliant

Brilliant [38] uses interactive problems solving to help students, teachers, and all other sorts of professionals to build math and science skills. Their strong mobile onboarding experience seemingly highlights their offer, thus setting precise and correct user expectations.

Delighters in Brilliant's mobile app onboarding experience are [36]:

- Absorbing. Each screen in Brilliant's onboarding provides a short recap on why their method guarantees success, thus wasting no time to convince users they are gonna build strong math and science skills. A good example of this is their citation of Picasso in the welcome screen.
- Simple. They offer all most common single sign-on options (Apple, Facebook, Google) and make it easy to create an account. This helps new users overcoming the account registration barrier in a very short time.
- Helpful. The app offers content tailored to individual needs of people, and they make it clear by asking if you are a student, teacher, professional, or simply passionate about science.
- Direct. Brilliant pays a great attention at underlining their value proposition upfront, before users get conducted to a free-trial, and also on the free-trial page. Since getting users to pay for an app is always complicated, their captivating sell together with a full access trial is a wonderful approach.

2.2.1.3 Strava

Strava [39] started off as a GPS-tracking app for running, but today totes itself as the "social network for athletes" and provides training goals, community events, and more resources.

Strava does a good onboarding job for new users but also for existing, avid users, to convince them to switch to higher-tier plans. The more you use app for your workouts, the more their prompts and onboarding adapts to sell a premium plan while educating users on its true benefits.

Delighters in Strava's mobile app onboarding experience are [36]:

- On-topic. Their careful targeting and segmentation makes this upsell prompt feel relevant to someone using Strava multiple times a week, and might want new, premium features to take their training to the next level.
- Aesthetic. Their up-sell page provides effective screenshots showing what you gain access to by upgrading, thus helping to sell the app.
- Attractive. Features like live location sharing and custom goals are both very appealing to frequent runners and cyclists.
- Uncomplicated. Strava uses a call to action button that is always at the bottom of the screen, with straightforward yet compelling copy, thus making it easy to get you to click and move to the next step.

2.2.1.4 Estately

Estately [40] is a home purchasing app claiming to have highly qualified agents and the fastest update rate for listings, while using the same data providers as other realtors.

Delighters in Estately's mobile app onboarding experience are [36]:

- Effortless. The onboarding process directly asks for the most fundamental parameters of an home purchasing search. In this way customers are able to start using the app effectively as soon as possible.
- Minimal. Their onboarding screens nicely designed but very minimal, with no branding.
- Timely. At the end of the onboarding experience, the user sees a contextualized push notification request to set real-time alerts when new houses matching his search filters are available on the market.

2.2.1.5 Sephora

Sephora [41] establishes itself among the greatest companies in the beauty industry, and part of their wide fame is due to the tailor-made and smooth omni-channel shopping experience provided to their consumers.

This seamless experience starts from a well-designed mobile app, providing personalized home screen and product recommendations.

Delighters in Sephora's mobile app onboarding experience are [36]:

- Branded. Sephora is very well known for its distinguished black and white stripes. The heavy usage of their brand identity right from the onboarding experience helps legitimizing the app and inspiring assurance in the mobile shopping experience.
- Motivating. Sephora tries to persuade customers of the superior experience guaranteed by shopping with them, and it does so by highlighting enticements during the onboarding experience. They dedicate an onboarding screen to their fidelity program in a clever effort to gain new and current users' trust.
- Convincing. Making users choose to receive push notifications and having their location tracked while using the app are crucial steps for building involvement and customer value. Sephora makes use of perfect words to generate a feeling of rarity and urgency, thus encouraging users to concede these permissions.
- Integrated. Exploiting cutting-edge technology is crucial to make customers stick to the app. Sephora provides an easily integrated shopping experience with latest technologies such as Face ID login and Voice Search.

2.2.2 Brain training apps

Recent blog posts, such as [42] and [43], try to determine the best educational apps in the landscape of brain training apps. Some other apps to be described in the following are not mentioned in the previous sources are among the first results for number of downloads and average rating on Apple's App Store [44]. This list includes all major competitors of Elevate and some slightly different but yet successful apps.

2.2.2.1 Lumosity

Lumosity [45] is a brain training app that encourages users to play games that challenge their mind and improve cognitive skills such as memory, attention, and problem solving.

The onboarding process revolves around creating a personalised user experience based on training goals. Each training goal correspond to a category of games available in the app, and this is made very clear by the fit test included in the onboarding experience, pushing the user to play three games in order to get an initial cognitive level and get started with the training program.

Right from the onboarding, the science behind a game is thoroughly explained in order to make users understand what they can hope to achieve by using the app.

Lumosity's onboarding clearly states the need to execute three ordered tasks in order to get started, and the reasons behind this need: take a fit test by playing some games, get an initial cognitive score based on the fit test, calculate a tailored training goal. This clearly stated progression increases user involvement in getting things done.

The possibility to try some of the actual games during the onboarding increases the awareness of what the app is going to offer, and of why certain features like personalized games and statistics might be useful, thus justifying the request to up-sell to the paid version. However, the user can easily discard this option and continue with the limited version.

As the games on Lumosity are all about improving cognitive ability, they change daily in order to give users a new challenge and increase their skills with more complicated tasks. This means that onboarding is a constant task for the app because new games need to be explained before use.

Opening a game that was never played before starts a quick and easy tutorial that helps the user to get started. These tutorial are often interactive, so users can have a go before starting the actual exercise.

2.2.2.2 Peak

Peak [46] is a brain training app designed to challenge your cognitive abilities. Its games consist of brief and intensive training sessions designed around your life. Cognitive skills are challenged with games testing your Focus, Memory, Problem Solving, Mental Agility and more.

To address everyone's own goals, the personal trainer 'Coach', an in-app avatar, guides you to achieve your Peak goals. Coach tests you with new workouts, tracks your

improvements and explains you where and how you can progress, giving motivation and pushing you over your limits.

A statistics page is used to display your brain map, which changes over time as a result of your performances in the games. The app also enables comparison of your brain map with friends on social media, your age group and professionals in your industry.

As with Lumosity, Peak uses an onboarding flow that includes trying three games to create the first brain map, and explanations about the scientific studies behind games. In this case, tutorial are less interactive, but shorter.

In Peak, there is a lighter focus on the pro version during the first session, since it is not mentioned during onboarding.

2.2.2.3 MentalUP

MentalUP [47] Educational Games is an app aiming to provide a successful way of developing your mind with hundreds of enjoyable brain games. They have memory games to increase learning ability and alertness games to improve focus.

Every game starts with a quick tutorial prior to the timed challenge. Players can decide to develop more specifically certain abilities, and to take their age into account for the selection of games.

Achievements and progress are provided in a reports screen. The user can personalize his avatar with accessories by spending in-game money earned through exercises.

Their onboarding instantly shows that the app focuses more on children, both in terms of games and UI design, although an option for adults is also available.

No game or test has to be performed during onboarding, but the user has to choose his training goals.

Before landing on the main game screen, or before starting a new game, a request to switch to the pro version is presented with a first-time discount and a convincing message. During the outbreak of the COVID-19 pandemic [48], for example, they present this discount to help families cope with schools shutdown.

2.2.2.4 GEIST

GEIST (formerly Memorado [49]) is a revamped and re-branded app that provides users with an all-in-one brain training and mental well-being solution. It does this by offering a range of tiered brain training workouts alongside meditation programs and mindfulness exercises [43].

When you launch the app, GEIST asks what cognitive goals you might have – do you want to focus more, remember names more easily, or think more quickly? After, you are prompted to complete a first workout, which is a brain training exercise that includes a range of games.

The onboarding process is very different than other competitors: there is no sign-up process, and no ability test. The user is brought straight from training goals to an up-sell screen and then to the main screen of the application. The onboarding

includes a counter of screens to be evaluated in the upper-right corner, making the user understand how many steps are necessary to get the job done.

Both the sign-up and the ability test are postponed to the moment when the app is fully available to be explored. This, from one point of view, accelerates the first set-up. But on the other side, it removes any possibility to understand what the app might offer before getting confronted with the up-sell choice.

2.2.2.5 CogniFit

CogniFit Brain Fitness [50] is a brain training app targeting the improvement of mental attention and cognitive skills. Its ordered training program assesses global mental health and fitness. This program is conveyed in a game-like fashion to create enjoyment. Users can monitor their progress and consult insights about overall brain fitness. Competitive players can also propose challenges to their friends.

The app's foundations are accepted theories of neuroplasticity and neuroscience, backing up the claims to sharpen memory and improve attention.

CogniFit has a higher price compared to competitors, but they show their up-sell screen quite later than other apps. Their onboarding includes some explanation steps on the games and their clinical validity, followed by the sign-up. No up-sell, nor skills test.

After this, the user lands on the app and is free to look around: in every tabs there are tips to guide the first-time experience.

Only when starting the first training session the user is presented with the choice to access more games and features with the pro version, or to continue with a limited version and start playing.

In this case the onboarding experience is shorter and the up-sell moment is quite postponed, allowing the user to get acquainted with the structure of the app before deciding on the pro version. However, this happens before playing any actual game, so the choice might still be though.

The up-sell screen includes a detailed explanation of the clinical and research institutions supporting the effects of these cognitive games.

2.2.2.6 Eidetic

Eidetic [51] is a brain training app with a focus on memory, using the space repetition technique to facilitate memorization of anything from lists, quotes, phone numbers, notes, and other useful real-life applications.

Eidetic uses a flash card-style approach to perform spaced repetition. Users easily choose the intensity of the training, and notifications remind them at the moment of a new test, spacing out tests over time to make sure that retain the information in long-term memory.

This app does really not have an onboarding, and required no registration. The user is simply prompted to create a first test, and upon creation of a second test confronted with the possibility to unlock the pro version with a one-time payment.

2.2.2.7 Impulse

Impulse - Brain Training App [52] proposes challenging and entertaining mental games to improve your mental fitness through short brain workouts.

The range of training games at the user's disposal aimed at boosting your cognitive abilities with a level of challenge that ensures you progress over time and along with any age and expertise level.

The onboarding process starts with a description of games and features, followed by a request to enable push notifications not better detailed by why to do it. After setting improvement areas, age group, and training intensity, the user sees the up-sell screen. Finally, no matter the choice, he lands of the first workout of the suggested 30-day brain challenge.

2.2.2.8 Left vs Right

Left vs Right [53] is a brain training app including 49 games that test and train your brain in 6 categories: Awareness, Adaptability, Reflex, Reasoning, Precision, and Patience.

In order to be able to train every day with games from each of the 6 categories, users have to become VIP members. In this status, they can also enjoy other features such as Category Brain Quotients, Category Percentiles, and your score history for each game. Regular members, on the other hand, have only access to a limited set of these features.

An interesting possibility this app offers is to play in Color Blind mode.

The onboarding includes 8 steps numbered at the top of the screen aiming at setting favorite improvement areas and optionally signing-up (this operation can be also done only later to sync progress across devices). No up-sell is shown in the onboarding, although it becomes clear from the first training session than a VIP package is required to play it all.

2.2.2.9 Mind Games

Mind Games [54] is a vast collection of games that are partially based on principles derived from cognitive tasks, and that help you practice different mental skills. Many of the provided games are free, while some trial games can only be played 3 times for a free user.

Each game provided your score history and a graph of your progress through time. Through the use of standardized testing, these scores are also converted to a standardized scale, in order to understand where you need work and improvement.

The onboarding process is quite empty of information for a new user, that gets requested for registration and opting-in push notifications. No information on games, pro features, or scientific validity is provided in this phase. After, the user is landed on the main screen of the app without additional details on how and when to train.

2.2.2.10 BrainHQ

BrainHQ [55] presents itself to users as a personal gym for your brain, where it is possible to train your memory, attention, brain speed, interpersonal skills, intelligence and navigation.

The onboarding includes some explanation screens, the last of which invites the user to play for free to improve his cognitive skills. Right after, the sign-up screen is shown, and then the user lands on the main screen.

From the main screen, it is easy to guess the objective is to play the "daily spark", a 1-game daily session. After playing, there is no prompt to up-sell. However, the user will be told to upgrade if he tries to play more than 1 game per day or wants to access all the other games.

2.3 Methodology

To establish a correct methodological approach for this thesis, I decided to define a design process that combines principles from multiple frameworks in the interaction design field, such as Human-Centered Design, Goal-Directed Design, Participatory Design, and Minimalist Instruction.

2.3.1 Design frameworks and principles

The application of traditional scientific research to design is complicated by the fact that design is about solving problems that have unclear definitions and whose requirements are in continuous change [9]. According to Gaver [56], design should not try to be falsifiable, since it differentiates from scientific research in its search for "what might be", rather than for "what is".

For the above mentioned reasons, an agreement among theories might not be a good fit for design. Alternatively, diversity in practises and theories might be of greater help to develop better frameworks and methods. This is why Gaver ultimately suggests that design should get its strength from the development of different solutions to the same problem, which leads to a result that includes multiple perspectives.

2.3.1.1 Human-Centered Design

Human-Centered-Design, or HCD, can be described as a design framework with a focus on people and their relation with objects [57]. This framework emphasizes the importance of creating usable systems by meeting requirements, while including the ideas of the final users, as well as involving them into the design process. Its methods and recommendations for managing a design process are standardized in ISO 9241-210:2010, Ergonomics of human-system interaction – Part 210: Human-centred design for interactive systems [58].

The ISO specification describes four phases to be iterated in cross-functional design teams. The first phase consists of observing and understanding potential users and their tasks. The knowledge produced by this research is consequently

used to define relevant user requirements. In the following design phase, all the previous understanding is used to create solutions. Finally, the last step in the loop is an evaluation of how the current design solution satisfies the requirements. If this solution is not enough, a new round of research, requirements definition, and design is conducted. Prior to this iterative process, a planning phase is carried out to correctly implement HCD.

HCD is widely used to support design processes in several organizations. Among them, there is the famous non-profit design studio IDEO [59]. They created a personalized version of HCD, which consists of three phases resembling the ones described in ISO 9241-210:2010 [58]: Inspiration, Ideation, and Implementation. During inspiration, several studies are carried out to get a better understanding of potential users. Solutions are then generated during the ideation phase. Finally, developed solutions are tested and corrected until they satisfy the needs of users.

Not everybody considers HCD useful. For example, Norman [60] argues that humans embrace tools more than the opposite. He suggests that HCD focuses too much on customers, while many products in the world have been designed without even conducting any user research.

2.3.1.2 Goal-Directed Design

Goal-Directed Design, or GDD, is a behavior-oriented design framework, first developed by Alan Cooper [61]. Its foundations lay upon collecting a detailed understanding of what needs, goals, and motivations potential users may have. This approach lacks theoretical background, and was instead developed from real practises [62]. However, it is possible to establish a connection between GDD methods and anthropological and ethnographic studies. The starting point for GDD is mental models. According to Cooper, software designed according to mental models of the system is able to remove complexity and lead users to the accomplishment of their goals. Mental models are the tool connecting the user's daily life to the domains of the system. Customers' opinions should be acknowledged during the process, but are not fundamental when designing. [61].

The identification of the user's goals is the main objective of GDD [61]. Goals are different than activities and task, since they are behavior-driven. Goals provide motivation to people, so focusing on them during design means that a superior performance can be achieved and unnecessary activities can be avoided. In the book Emotional Design, Norman [63] analyzes three levels of cognitive processing: visceral, behavioral, and reflective. It is possible to associate a type of user goals to each of these cognitive processing levels: visceral processing corresponds to life goals, behavioral processing to end goals, and reflecting processing to experience goals. Life goals represent the deepest aspirations and dreams of users, which drives them out of the context of singular products. End goals correspond to the usage of products and services to perform a task. Experience goals are simple, personal goals, such as feeling amusement, control, and cleverness; they are usually hard for users to describe.

Goal-Directed Design includes six phases: research, modelling, requirements,

framework, refinement, and support [61]. The first step consists of research on the problem and potential users affected by this problem, using interviews, observations, market analysis, and literature. The result of the research is used during the modelling phase to develop behavior models, with the helps of tools like workflows and personas. Consequently, scenarios meeting the users' goals are developed to define requirements. Therefore, designers define the behavioral, physical, and visual characteristics of the solution. This solution is then refined in more detail, with a focus on how it will be implemented. Lastly, designers assist the engineering team in the phase of development support.

2.3.1.3 Participatory Design

Participatory Design, or PD, is a design approach that highly involves potential customers [64]. Also known by the names of cooperative design or co-creation, it provides techniques, to be used both during research and ideation of a product, which give end-users an active role in the design of solutions for their problems.

Find out how end-users would solve a challenge they directly face can provide interesting insights about their experiences and actionable inspirations for designers. [65]. No matter the type of customer, thanks to this information designers can focus their attention on how the product needs to be used to solve people's problems and achieve their objectives.

2.3.1.4 Minimalist instruction

Minimalist Instruction, or MI, is an instructional design framework developed by Carroll [11] in opposition to the traditional hierarchical training manuals for software. Its main principle is that users should have less to read and more to do, so that they rapidly recover from errors and achieve mastery with the software.

Carroll observed that balancing the user's need for information with his tendency to explore and produce is a great way to give them a feeling of control and confidence during the learning process. In the early steps of this learning curve, users have an urgent need of making tangible progress towards their objectives. Similarly to the "quick win" in onboarding [1], Van der Meij and Carroll [29] connect this idea to the generation of a list of short-term goals that correspond to quickly changing learner goals.

Strahm et al. [6] discussed how minimalist instruction can prove to be a really relevant and valuable framework in the creation of onboarding experiences, both for professionals and for the HCI community. The usage of minimalist instruction as an analytic and design framework contributed to their approach to the research goal by establishing onboarding as part of a new user's meaning-making or interpretive process. Just by using a low-fidelity prototype, they were able to quickly identify insights about user perception, behavior, and mental models.

Using minimalist instruction to design onboarding helps creating a validated list of user-centered instructional design principles. Posing attention on how the user's sensibility to elements of the interface evolves grants the possibility to gather practical insights for onboarding content, form, and placement [6].

2.3.2 Research approaches and technologies

After discussing similarities and differences among design frameworks, this section presents the methodological approach for this project, that combines elements from all the four frameworks previously described.

2.3.2.1 Inspiration

During the ideation phase, inspired by the IDEO field guide [59], I tried to get a detailed understanding of Elevate's customers. As suggested by Hulick [1] and Intercom [12], the main objective of this phase was to identify the value propositions of the product and the switching moment in the onboarding. By involving active users of the product, I tried to get an understanding of their life and their habits, as suggested by Eyal [24].

Literature review and competitor analysis This chapter has focused on a review of literature on user onboarding, state of the art in existing apps, and competitors of Elevate in the field of brain training. As stated by IDEO [59], performing research on existing theories and analyzing rivaling products in a good starting point for any design work. Cooper argues that performing literature review helps with the definition of questions for subsequent interviews with customers and other stakeholders [61].

Quantitative research with business analytics platforms Intercom [12] suggests to track user sessions in order to find the bottlenecks of the first-day experience with a service.

At Elevate Labs users' interactions with the app are tracked and investigated through the business analytics platforms Looker and Amplitude.

Looker [66] is a business intelligence software and big data analytics platform that helps you explore, analyze and share real-time business analytics easily. This tool makes it easy to transform queries on tracking events generated by your product into easily-readable graphs and tables.

Amplitude [67] is a product analytics service that makes it easier for companies to understand user behavior, ship the right features and improve business outcomes. Tracking events can be combined on Amplitude to create funnels and show how users move from one screen to another and which actions they perform along the way. For onboarding, this is particularly useful because it helps to understand which are the most critical points where the user's behavior deviates from the intended one.

Qualitative research with active users interviews According to IDEO [59], qualitative research is the most fundamental part of the inspiration phase, since interviews make it possible to design according to people's motivations. Asking questions to potential customers and relevant stakeholders gives them the possibility to describe their perception of the domain and what they expect from the product.

But finding the right people to talk to can be challenging. IDEO recommend to use a design activity known as Recruiting Tools [59] to determine who to interview, and withing this technique they suggest to focus on both mainstream and extreme users. This provides a wider range of perspectives coming from the activity.

At Elevate, Looker [66] is used to select people for qualitative studies, according to their demographics, game-play statistics, and other parameters related to the main platform they use to play.

2.3.2.2 Ideation

In the ideation phase all the findings collected from the previous studies are synthesized into design ideas. According to IDEO, this phase helps to interpret the gathered information as well as to generate prototypes to be later implemented and evaluated [59]. For this reason, in this project, the ideation phase is quite intertwined with successive iterations of the inspiration phase.

Theme definition and prioritization IDEO suggests the use of a design activity where designers organize notes into categories, in order to identify key themes, i.e., areas of development [59]. This activity, showing similarities to affinity diagrams, generates insight statements that can help distinguishing which areas of development better correlate to the design challenges posed. Later, these insights can be rephrased as questions that start with "how might we", that can in turn be used to generate bets, i.e., possible design answers to the problems identified.

Personas In the context of goal-directed design, Cooper states the modelling users is fundamental to create design solutions that match the goals of users [61]. A common approach to modelling users is personas, a fictional character created to represent the needs and traits of a potential real user [57]. Cooper argues that the research carried out during the inspiration phase can generate an accurate development of personas [61], which helps to discuss motivations, needs, and objectives of potential users within the team and to stakeholders, but also to test the usefulness of design solutions.

At the same time, Cooper stresses the importance of being aware that personas are not real users, so they cannot represent a replacement for user studies and tests [61]. Others like Chapman [68] and Pruitt [69] have criticized the overuse of personas for the difficulty in determining how accurate they are.

Journey mapping is another design tool used to model users. Journeys are visual stories mapping user needs to their behavior with the product [70]. A journey map is shaped like a timeline paired with actions and objectives of the user. In the IDEO field guide [59] journey mapping starts from the moment the user becomes aware of the product, and includes interactions until he becomes a frequent user. Journey mapping shares characteristics with what Hulick describes as understanding the stories of users [1].

In this project, I provide broad definitions of potential users, and use those to select prospects for user studies and analyze data coming from these studies.

However, I do not formally define personas as fictional characters guiding the whole development process. Amplitude charts [67] are used to build customer journeys during the onboarding experience.

2.3.2.3 Implementation with Agile methodologies

In order to implement the proposed solutions, this project follows the software development practices used at Elevate Labs, based on Agile methodologies and Scrum.

Agile Agile software development [71] denotes software development methodologies focused around iterative development, in which requirements and solutions evolve thanks to self-organizing collaboration in cross-functional teams. Agile development has a great value in giving teams the possibility to deliver value faster, with greater quality and predictability, while keeping a better propensity to respond to change. Scrum and Kanban are two of the most widely used Agile methodologies.

Scrum Scrum [72] is an agile framework for developing, delivering, and sustaining complex products. It has been initially used in software development, but later it has been employed also in other fields, such as research, sales, marketing and advanced technologies. Scrum is designed for small teams including no more than ten members, who break their work into goals that can be achieved within each time-boxed iteration, called a sprint. Sprints should commonly last between two weeks and a month [73]. The Scrum Team tracks progress in daily scrums, 15-minute time-boxed daily meetings. At the end of the sprint, the team discusses results in two final meetings: sprint review is hold to show the work done, while sprint retrospective is used to discuss issues and continuously improve the process.

2.3.2.4 Evaluation

During the evaluation phase, new design solutions are tested against existing solutions to determine the user's response to change [5]. In the context of this project, evaluation of changes to Elevate are also used to attempt a generalization of findings to onboarding experiences in other types of mobile applications.

A/B Testing Optimizely describes A/B testing as an evaluation process to compare the performance of two different solutions by administering them to different user groups [74]. The first step in this process is to collect data in order to analyze which factors to optimize, and which conversion goals and metrics to observe for the determination of whether a change generates success or not. Once these are defined, hypothesis are generated on the variants to propose to the different user groups. Once the variants are developed, the experiment is executed for a time-boxed period of time. Finally, results are used to compare the performances of the proposed solutions [74].

A/B experiments should not interfere with each other, in order to not create confusion in the results. Running tests in parallel can make it impossible to tell apart the sources of each observed behavior.

Goodson provides some recommendations for the realization of good A/B tests [75]:

- Generate valid hypotheses.
- Use power calculation to determine a correct sample size.
- Do not interrupt tests earlier, instead try to validate them with successive iterations.

Despite A/B tests are really good at telling what behaviors happen more than others, they are not so good at telling the why they do. Carlen [5] and Creswel [76] argue that this kind of evaluation should always be accompanied by user studies to properly validate the changes. However, questions to users should not focus directly on the change, but more on comparing their satisfaction level with the product while using different variants.

At Elevate, A/B tests are evaluated by the means of two-tailed [77] z-tests [78] at 95% confidence [79]. Sample size is calculated with publicly-available tools like Evan Miller's Sample Size Calculator [80].

3 Research material and methods

3.1 Inspiration and Ideation

This project uses a slightly modified version of the HCD process, where the inspiration and ideation phases are connected in an hybrid process including iterations.

An initial inspiration work has been executed by:

- Reviewing the literature and theories of the Background section.
- Analyzing the current onboarding flow in Elevate.
- Retrieving high-level quantitative and qualitative information from Elevate's analytics and customer support software.

This research was the foundation for the first ideation phase, starting from the definition of themes and possible bets in a process involving several members from all teams (product, design, engineering, QA).

The definition of the so-called First Impressions theme triggered a series of cross-team brainstorming discussions in order to generate a more detailed research plan, input to a second, more detailed, inspiration phase.

After gathering and grouping information from this user research process, I planned with the product team a set of requirements for features in the user onboarding flow to be implemented and tested in the context of this project.

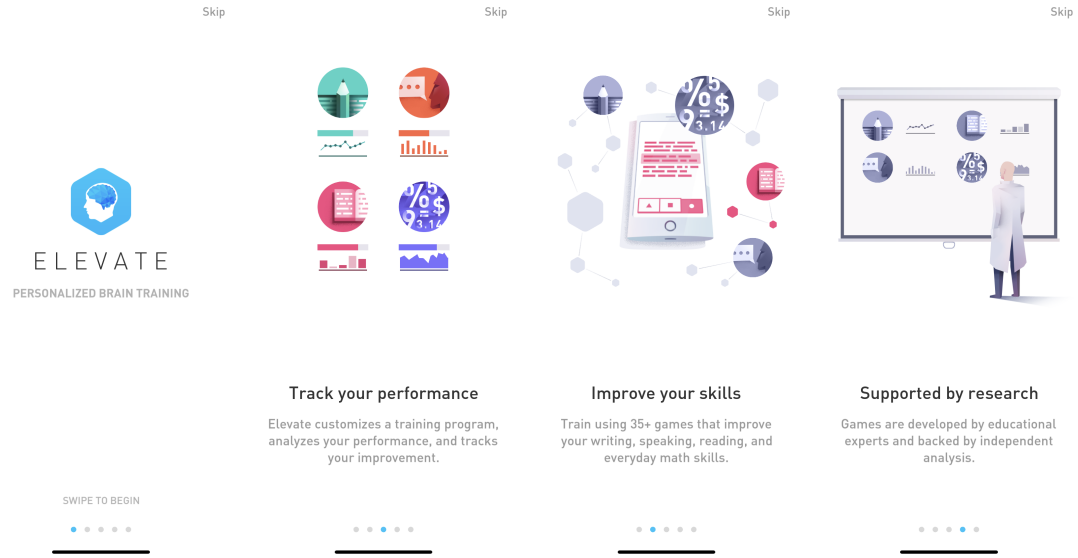
3.1.1 Current onboarding tear-down

As recommended in [1], I performed an onboarding tear down in order to drive the research on the problems and inconsistencies of the current onboarding flow of Elevate.

The first onboarding can be divided in these main phases:

- Welcome screen and description of the product
- Choice between signing up and signing in
- Training goals
- Training test
- EPQ introduction and calculation
- Sign-up
- Up-sell
- Notifications setup
- First training session

3.1.1.1 Welcome screen



(a) Welcome screen (b) Performance (c) Cognitive skills (d) Experts support

Figure 2: Welcome screen and description of the product

The welcome screen has the aim to introduce a new user to what Elevate is and what kind of foundations it lays upon. This information are provided in a pager of five tabs, but the user is also offered the possibility to quickly jump to the last page and sign up/in.

The first tab literally tells what Elevate is: Personalized Brain Training. The intermediate tabs synthesize in three statements what that practically mean: tracking your performance as you improve your skills with games supported by research.

3.1.1.2 Sign up/sign in choice

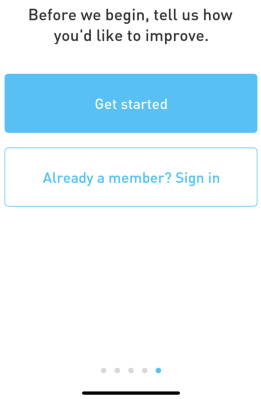
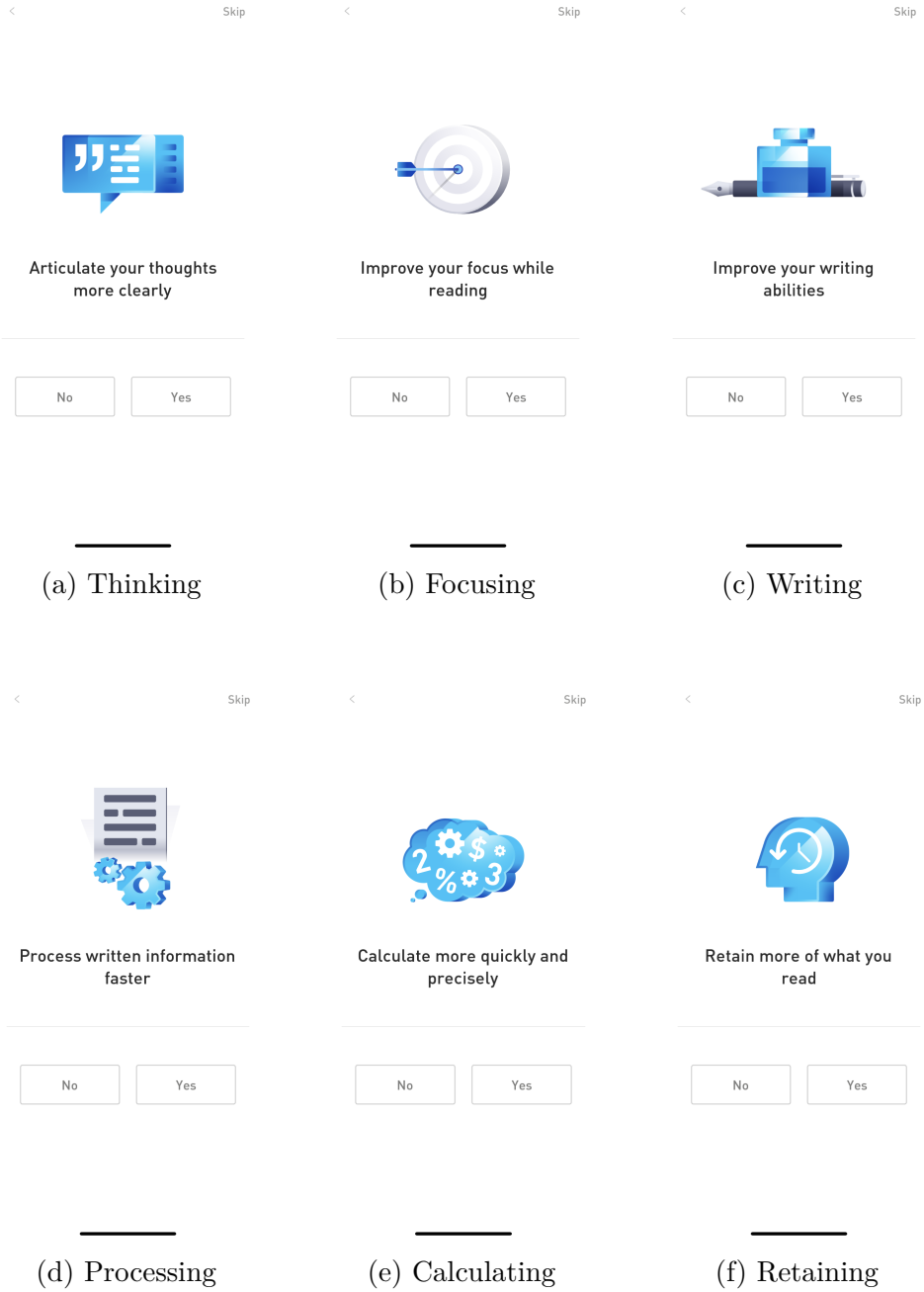


Figure 3: Choice between signing up and signing in

The last tab in the welcome pager invites the user to get started, anticipating the following section about training goals. It also offers the possibility to enter with an existing account.

3.1.1.3 Training goals



(a) Thinking (b) Focusing (c) Writing

(d) Processing (e) Calculating (f) Retaining

Figure 4: Training goals

The section on training goals informs the new user's training plan with a choice among the skills he wants to focus on. The six goals are then presented simply with an image and a yes/no question.

Again, there is a possibility to skip this part and give the same importance to each training goal.

3.1.1.4 Training test

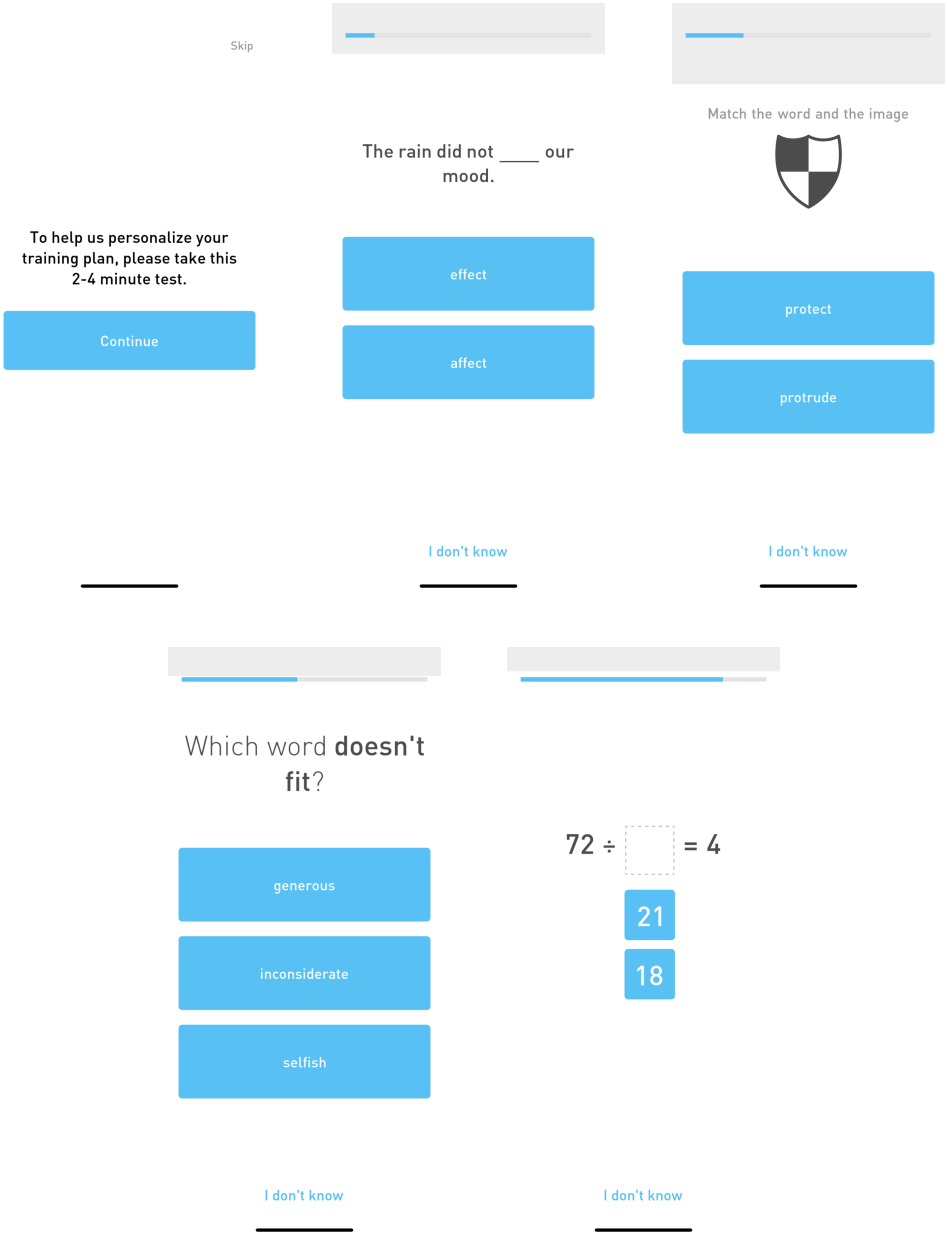
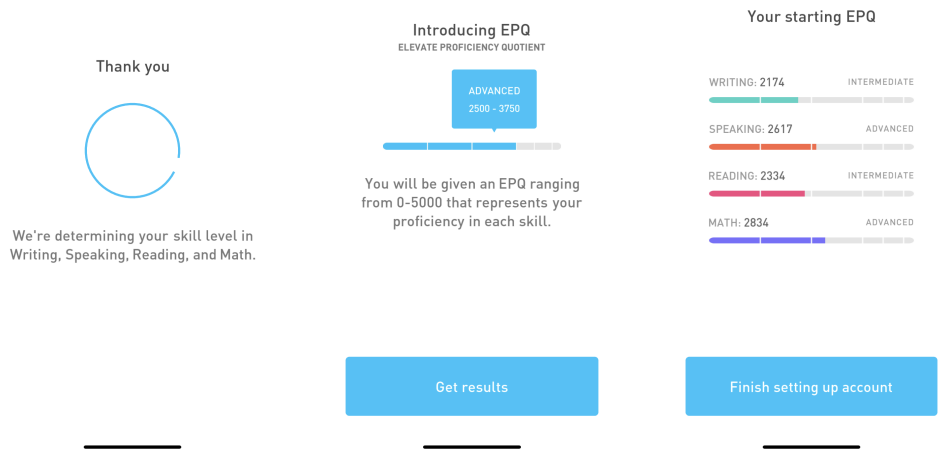


Figure 5: Training test

The training plan that Elevate elaborates for a new user does not only depend on his goals, but also on his current level of ability. The training test uses a few quick questions about language and math to assess this.

The user can skip the entire test and provide a personal estimate of his own skills, or skip single questions he does not know how to answer.

3.1.1.5 EPQ introduction and calculation

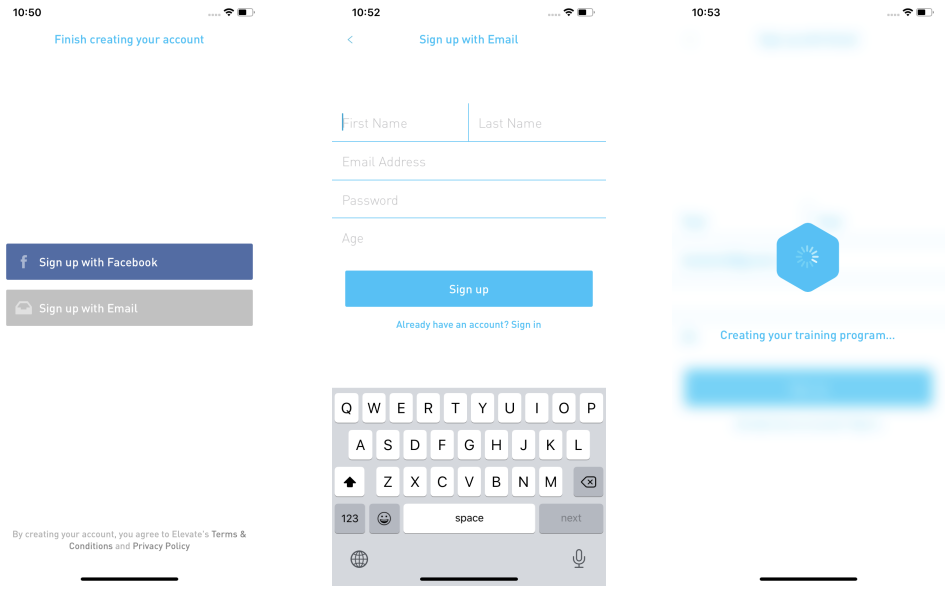


(a) EPQ calculation (b) Explanation (c) Initial score

Figure 6: EPQ introduction and calculation

The result of the training test and, later on, of the games contributes to a score named EPQ (Elevate Proficiency Quotient). This score ranges from 0-5000 and represents the user proficiency in each of the main areas addressed by the app: Writing, Speaking, Reading, and Math. In this section the score is presented to the user, together with its initial values.

3.1.1.6 Sign-up



(a) Options (b) Sign-up with email (c) Training program

Figure 7: Sign-up

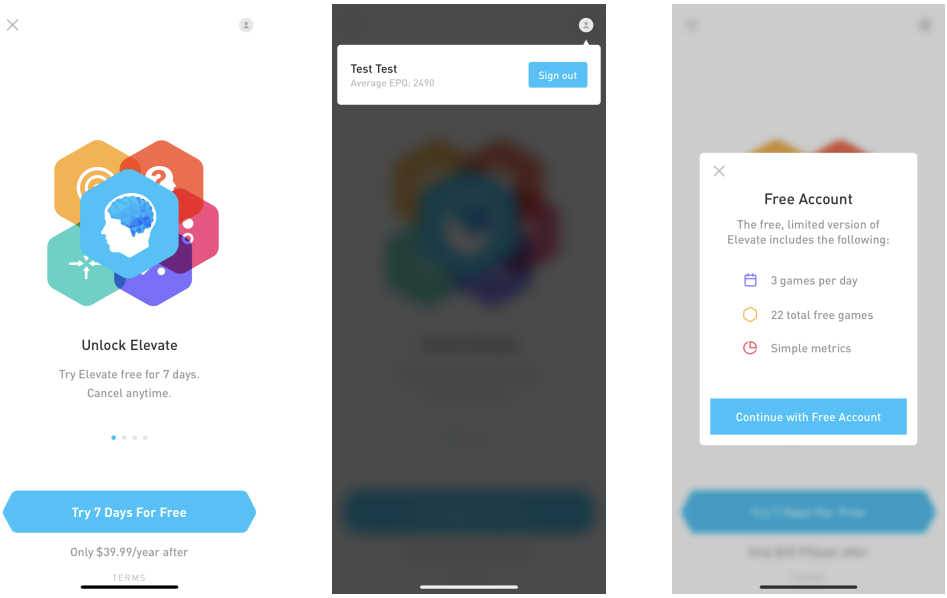
Elevate includes two sign-up options:

- Facebook's Single Sign-On
- Email sign-up

While the first option uses a third party authentication system to create a user account and fetch the necessary information, the second option needs the user to input its personal data.

After correctly inserting registration data, the information on training goals and EPQ are put together to create the training program.

3.1.1.7 Up-sell



(a) Free trial (b) Logout (c) Free version

Figure 8: Up-sell

After getting the user on-board and ready to play, Elevate asks him whether he wants to play a free, limited version of the app or purchase (with an initial free trial) the complete version.

This up-sell screen emphasizes the possibility to start a trial for free in order to enjoy the benefits of the full version without an immediate commitment. However, the user is offered the possibility to either log out or close this screen and continue with a free version. The differences between the paid and free subscriptions are clearly stated by the popup appearing before finally dismissing the up-sell.

3.1.1.8 Notifications setup

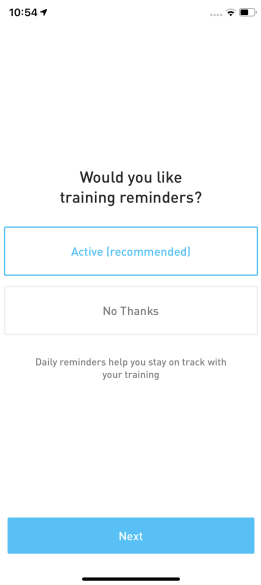
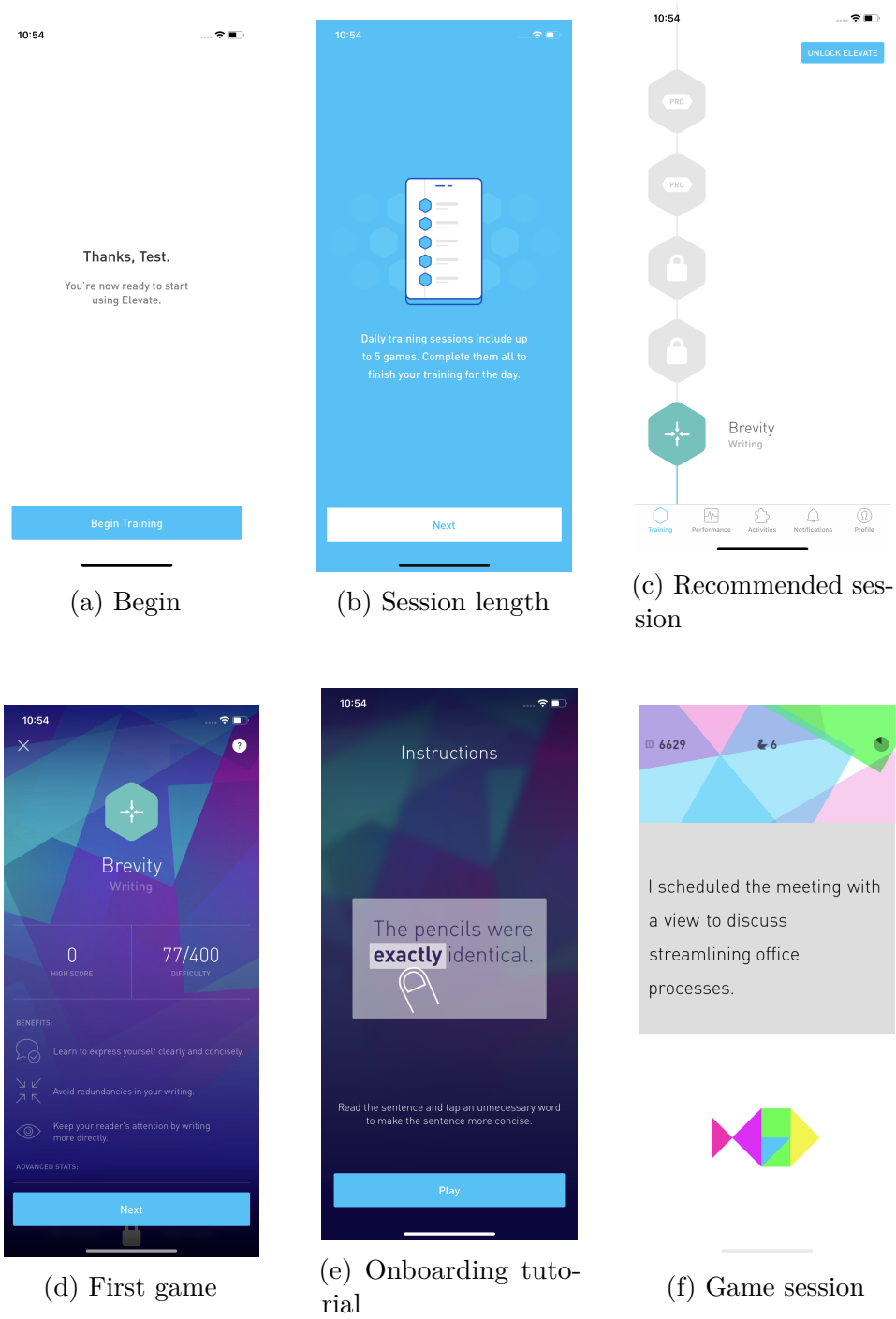


Figure 9: Daily reminders

Last but not least, the app requires permission to send notifications for training reminders, to be sent daily for the user to keep its right pace at training.

3.1.1.9 First training session



(a) Begin (b) Session length (c) Recommended session

(d) First game (e) Onboarding tutorial (f) Game session

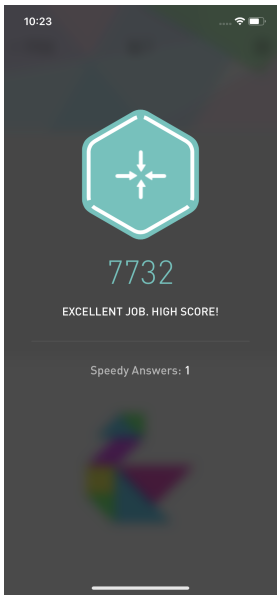
Figure 10: First training session

The first training session includes some tips to make the user acquainted with the training plan and its games.

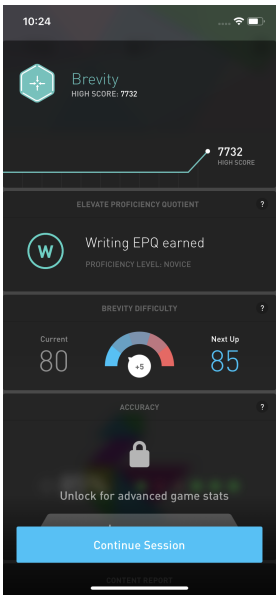
First, the user is reminded of the length of daily training sessions. This is initially

set to 5 games for pro users or to 3 games for free users, but can be lowered in settings.

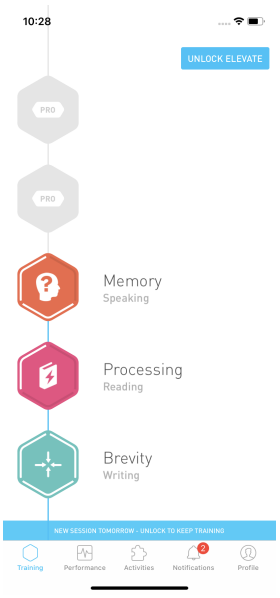
The first game of the session automatically opens, and as with every other game the user plays for the first time, a brief tutorial is shown to explain the context and benefits of the game, and how to play it.



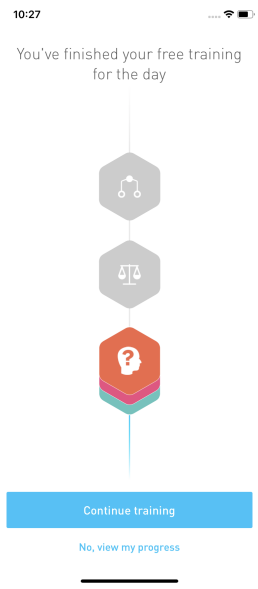
(a) End of game



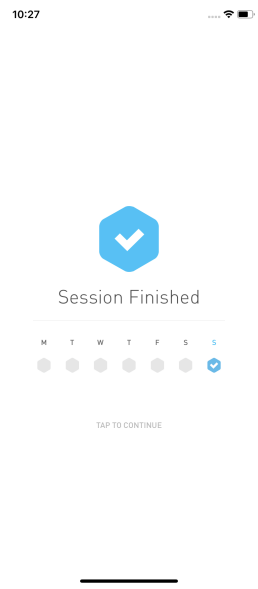
(b) Game report



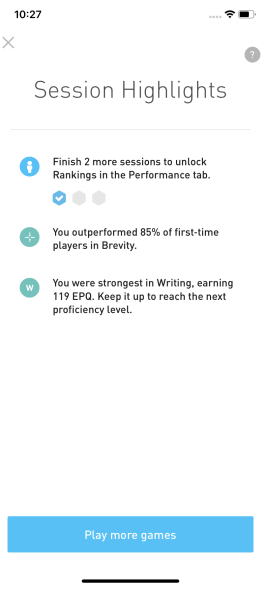
(c) End of free session



(d) Continue session



(e) Week progress



(f) Session highlights

Figure 11: First training session (continues)

After the end of the game, the score is calculated and the user can see his progress for the underlying skill in the detailed report.

After playing the number of games available for its training session, if the user is on a free account he is reminded to unlock pro to continue with the remaining games.

Finally, a calendar view shows the times he trained over the week, and session highlights give relevant information about the performance, EPQ level, and achievements.

3.1.2 Themes and bets

In order to correctly define a plan of interventions for the user onboarding flow in Elevate, I first analyzed the product's value propositions and defined actionable metrics of success to be evaluated later on.

3.1.2.1 Vision and user needs

Elevate's vision can be summarized in these two statements:

- As a company, Elevate leads a global movement to harness the power of the mind, helping billions of people live healthy, joyful, and productive live.
- As a product, Elevate provides the most engaging, adaptive games and tools on the market for building mental-fitness skills. Elevate works for users of all skill levels, and supports their personal, professional, and educational goals.

In lights of these considerations, the Elevate app addresses the following categories of users and problems of theirs:

- All audiences
  - Feeling less-than-confident using everyday verbal and mathematical skills
  - Feeling friction navigating our complex world
  - Desiring to stay sharp
- 55+ personal users
  - Worrying about, or experiencing, cognitive declines
- Learners of English
  - Wanting to improve English, sometimes as a foreign language, starting from advanced proficiency
- Workers
  - Seeing performance gaps in verbal and mathematical areas of work

3.1.2.2 Value propositions

Taking in considerations the previous categories of users and the problems of theirs Elevate tries to solve to achieve its mission, the value propositions can be defined as:

- For people who want to improve their day-to-day quality of life, Elevate offers fun, engaging opportunities to help build mental fitness, confidence, and communication and math skills.
- For those 55 and up, Elevate offers proven tools to help stay sharp and focused.
- For students and professionals, Elevate offers proven tools to improve communication and math skills.
- For more proficient learners of English, Elevate offers a unique way to engage with advanced applications of the language.

3.1.2.3 Northstar metric

To measure the delivery of value to users over time, I defined a northstar metric for the Elevate product, together with primary goals for this project in pursuing this northstar.

A good northstar measures a product behavior that correlates strongly positively to business impact, representing real value to customers. It also needs to decompose into input metrics that are actionable through product activities executed in the context of the project.

Since Elevate's core model of value delivery is learning via gameplay, the northstar metric is defined as Total Pro Active-User EPQ. In other words, the total volume of EPQ among Pro users who meet an activeness criterion, normalized for any adjustment of the EPQ system over time.

The way activeness is defined in the metric is iteratively defined in different phases of the project through analysis of behaviors.

Among the input metric to this northstar, a crucial role is played by the New Pro Active Users metric, that can be associated to this user onboarding work. This input can be subsequently decomposed in directly actionable inputs, such as:

- Free, non-trial user engagement/upsell
- App-store ratings
- Trial starts over first-time opens
- Week 1 EPQ gain per Active User
- Games played per trial
- Training completions over training sessions

This work aims at moving some of these input metrics to address two main goals related to the efficacy of the onboarding process:

- Decreasing unsubscribe rate, the number of paid users who unsubscribe (disabling auto-renew) as a percentage of total paid users
- Increasing 28 days paid-retention rate, the percentage of new user who are active paid users 28 days after first opening the app

3.1.2.4 Prioritized themes

A cross-functional brainstorming work has been carried out to elaborate on product opportunities focused on the user onboarding, and aiming at the goals defined before with respect to the northstar metric. This work has involved talks with members of different teams (engineering, design, product, content, data, QA) to define:

- Themes - broad areas of opportunity to move metrics critical to the strategy
- Bets - specific learning and making activities planned to be undertaken

The brainstorming activity has given light to two prioritized themes, and their relative bets:

- First Impressions - Pre-trial onboarding, representing the first interactive and direct experience the user has of the app, and including everything between the initial onboarding pitch to the start of the first training session. Bets:
  - Provide more entertainment value to the onboarding quiz
  - Personalized first session
  - Re-think the way we communicate the trial experience to users
- Trial Journey - User experience during the trial period, often activated during onboarding and suffering from a high rate of early unsubscribes. Bets:
  - In-trial motivations, such as social media interactions, virtual currency, predictive performance metrics, limited access to experience-locked games
  - In-trial up-sells shown in the right place, at the right moment
  - Discount codes
  - Goals and milestones for long-term app experience

Due to the limited time boundaries of this project, the focus has been shifted to include only the first theme. In fact, First Impressions matches more closely the definition of user onboarding given up to this point, in terms of first-time experience.

3.1.3 Quantitative analysis of past behavioral data

I performed analysis of past behavior of Elevate users with respect to the current user onboarding flow in two stages:

- Before the definition of the First Impressions theme, in order to drive the cross-functional brainstorming activity.

- During the definition of the First Impressions theme, in order to prioritize bets.

For the first analysis I pulled data from the Looker analytics platform relative to the different stages of onboarding, to highlight some numbers about engagement and drop-off. These are the most significant findings: TO DO

- 65% of users make it from install to registration, meaning they go through welcome, choice of training goals, and taking the training test.
- 75% of users complete registration after reaching the sign up options screen.
- 75% of users continue past the post-registration upsell screen, while many non-trial users drop off.
- 60% of users decide to opt-in for training reminders, while the rest starts using the app without granting this permission to the application.
- 27% of users come back to use the app after 1 day from first opening it, while 13% of users come back in the following 7 days.
- Previous changes to the onboarding flow had a relevant impact on early training session engagement, overall day-one retention, and session completion rates.

It is evident from numbers how small changes in this flow can have a huge impact, since in total only the 37% of users that decide to install the application actually manage to reach the end of the funnel and start using the app. The number of drop-offs is incredibly high in every step of the experience. Not to mention how having so many users not opting-in for training reminder notifications, 40%, prevents the app from having such an easy possibility to keep the user engaged on a daily basis.

It is also worth noticing how the retention rate drops from the end of the first day to the end of the first week, highlighting how the first session and the trial week are crucial to make the user stick to the application, but also how it is important to focus on re-on-board after churn. Being able to welcome back the user after the end of a free trial or a subscription with a captivating message and/or offers is another form of user onboarding that needs to be addressed during the entire life cycle of the product.

3.1.4 Qualitative analysis of users' impressions and goals

I performed two types of qualitative analysis, in order to gain insights both from active daily users of Elevate and from people who never saw the app before. The onboarding is a tricky area for such an analysis, it is difficult to ask about its pros and cons to users who love the app, because they went through it a long time before. This is why for the loyal users I conducted interviews focused on mental models about mental fitness, value delivery, and context of use of the entire app. To analyze the behavior of new users, instead, I designed a usability study focused on benefits, scores, and motivation during the onboarding and the first training session.

3.1.4.1 App usage interviews with loyal users

The interviews were conducted using a semi-structured method, consisting of several pre-planned and open questions which left room for the interviewee to ask follow-up questions.

The set of interviews on app usage has provided the output necessary to inform the cross-functional brainstorming activity leading to the creation of the First Impressions theme.

This research focused on answering three main research questions:

- **Mental models**: What is it about brain training and mental fitness that appeals to our users? And how do those ideas fit in to their lives?
- **Value delivery**: What about the app drives (user) value today?
- **Context of use**: When and where do users play Elevate? And what triggers them to play?

Participants were recruited following these steps:

- Pulling 2,000 prospects from Looker, among active pro users with an even distribution of subscription status, demographics, OS, educational level.
- Email them with details for the interview, technical requirements, and participant agreement.
- Select 20 participants while generating an ideal composition of group according to recruiting criteria detailed in the first point.

The interviews lasted for about to an hour. Pre-planned questions were used as a guide for the facilitator, but leaving room for open discussion and follow-up questions. The structure comprised the questions in A.

The synthesis of the interviews, carried out by grouping the user quotes in A, produced many interesting insights about the product.

The key value delivered by Elevate can be summarized in three words that were heavily used by participants: improvement, motivation, enjoyment. Taken together, these categories make for a helpful, concrete signal of what people get out of the app, to be reflected in value propositions and messages to users at various points in the experience.

It is clear that those areas of value are not always the same thing as having fun. The app has enough variety in games and content to be able to serve different people in different ways. It seems to be perceived as more interesting than fun, in part because sometimes the harder challenges for an individual participant are not enjoyable, and in part because the games are so heavily focused on instruction and learning.

The daily session is the core value-delivery mechanism and is synonymous with using Elevate as a concept. Free-played games (and to a lesser extent study guides) are value-additions. Some participants free-play specific games where they have

deficiencies; others free-play games they enjoy. It is not clear that all participants do free-play any games, and it seems that at least some of those who do see it as dependent on the amount of free time or energy they have.

People with motivation outside the app are Elevate's primary persona for product-market fit. Macro motivations (those that kept people wanting to use the app over time) were predominantly around improving performance at work or recovering from medical issues. People needing to be motivated by factors beyond simply learning makes sense alongside other insights, like the app not being exactly fun. Micro motivations (those that kept people actually using the app day to day, week to week) were largely related to an enjoyable daily routine, clearing the mind for the beginning or end of the day, and maintaining streaks and achieving measurable goals (around scores and difficulty level). All participants have a routine during which they use Elevate; some of these are triggered at times by the daily reminder notification, but the more powerful habituation device is likely simple pairing with an external part of a daily routine.

3.1.4.2 First Impressions unmoderated usability study

Broad objectives The goals of the usability study presented in this paragraph was to identify the user's experiences and impressions of Elevate on their first day - where they start and how they evolve. Specifically, we aim to identify the following:

- **Perceived upfront benefits**: What specific benefits does the user perceive the app to offer from the beginning?
- **Evolution of the perception of benefits**: How does the user's perception of benefits shift as they use the app in their first training session?
- **Usability and enjoyment**: How easy it is for the user to complete their first day, and how enjoyable do they find it? Are there clear points of friction?
- **Comprehensibility**: How intuitive is it for the user to form an impression on the benefits of Elevate? How intuitive is it for the user to understand key Elevate concepts (EPQ, the training session, etc.)?

Research questions I determined broad buckets of investigation during a Elevate cross-functional research plan synthesis meeting. These research questions and the interview script that follows come from the questions and observations of the broader Elevate product team:

- **Benefits**
  - Does our first day experience paint a consistent and amplifying picture of the ongoing benefits the user will receive from Elevate? (e.g. training goals, pitch cards, the overall experience).

  - How does the user perceive our personalized features on their first day, including the training session and their EPQ score? Are they aware that this personalization is happening, and what value do they place on it?

- **EPQ**
  - What does EPQ mean to the user? Will they use/care about EPQ?
  - Does the user understand EPQ? Do they have any misconceptions about it?
  - Does the user feel their EPQ score accurately represents their actual skill level?
  - Does the user think about and understand the role of EPQ throughout the remainder of their first day experience (game difficulty and overall training session)?

- **Motivation and momentum**
  - Is the user motivated by the app on the first day?
  - Does the user's EPQ score, quiz experience, or game performance affect their motivation and perception of what Elevate does?
  - Does the user understand what goes into their game performance (score, difficulty, rank (e.g. "Excellent"), etc)?
  - What about other confusions or friction in the onboarding experience? In the training session/games experience?
  - How does the user think about their experience beyond the first day, specifically in thinking about various motivational/habituation tools they have encountered? (e.g., training reminders, EPQ gains, daily training).

- **Value propositions and trust**
  - What, overall, does the user think Elevate does?
  - Does the user trust Elevate to provide this value? Are we seen as credible?
  - How specifically does this trust play out on the registration and post-registration upsell screens? Do users see the value of these steps?
  - How specifically does trust and credibility play out in EPQ and game scores?
  - Does anything else in the experience influence trust and credibility?

- **First day final impressions**
  - What parts of the user's first day experience are most salient for them by the end of the session?
  - How are they thinking about their onboarding experience (e.g. EPQ, etc) by time they finish their session?

Method I used unmoderated usability tests, run on the remote usability testing platforms UserTesting [81] and Userfeel [82]. The decision of splitting tests on two platforms was related to the lack of knowledge on which of the two provided better quality and benefits.

8 participants were selected with the following criteria:

- Target at least 2 participants per platform (iOS and Android).
- Target at least 4 participants over the age of 45, 2 over the age of 65, with a rough distribution of younger ages for the remaining participants.
- Location in U.S., where the app has the biggest market size.
- Aim for rough distribution of participant demographics otherwise (gender, education level, etc).

The screener used to select potential candidates had the objective of selecting users that did not know Elevate before but with interest compatible with the app's contents. I used these two questions:

- Which of the following activities do you do most often online (select one)? (User passed the screener if he selected a bold answer)
  - Watching TV/movies
  - Using social media
  - **Reading books/news/educational articles**
  - Playing video/computer games
  - **Studying new skills**
  - Shopping
  - **Doing crossword/sudoku/etc puzzles**
- Have you used any of the following apps (multiple selection)? (User passed the screener if he did not select Elevate)
  - Strava
  - Facebook
  - Elevate
  - Headspace
  - YouTube
  - MyFitnessPal
  - Duolingo
  - Tiktok
  - Candy Crush
  - Noom

Interview plan The interview script was presented directly to the user without moderation and was designed to elicit responses that could optimally help us answer the research questions. The user was prompted with an initial instruction to download the app with a link to the app store. The first instruction from the script took place with them on the Elevate app store page. From that moment on the usability session recorded the user's voice as he went through the instructions script while using the app. The script included the tasks in B.

Synthesis The synthesis of the usability tests, carried out by grouping the user quotes in B, produced many interesting insights about the product.

High scores and other universal game mechanics such as game difficulty, score calculation, or EPQ created confusion. Users were mostly unsure about whether their scores compare to other users' scores or not. In particular, the celebrating message for a personal best score saying "High score" was often perceived as misleading as they thought it was a high score compared to all other users and they could not believe to be better than all users on their first day.

Specific games and tutorial were unclear to users. Sometimes the static, non-interactive tutorials shown before starting a new game were mistaken for interactive ones, and the user did not understand how to proceed to play the game. In other cases, the game itself was unclear even after going through the tutorial. This posed a lot of attention on the importance of choosing the right games to be shown on day-one, and to implement mechanics that make it easy for a first-time user to succeed.

The speed of the overall experience could feel overwhelming. Both the onboarding test and some of the games had time constraints that created anxiety in the user in a moment when he wanted to take his time to understand the product and the different steps required to get started.

Many users did not fully understand what Elevate does at the beginning of the test, but they were pleasantly surprised at the end. This highlights how important it is to convey the right message about the value proposition of the app from the earliest steps, such as the App Store listing, the welcome screen, and the onboarding pitch.

3.1.5 Requirements

After analyzing the user findings coming from the inspiration and ideation phase, I defined a set of requirements for the projects, in terms of features to be implemented in the Elevate app to improve the efficacy of the user onboarding process.

These requirements include both features to be experimented through A/B tests and features to be directly implemented without an experiment. Even though the absence of an A/B test makes it difficult to analyze the impact of a single feature independently from the others, this choice has sometimes been forced by external requirements related to the development of the underlying platform (Android and/or iOS).

Following sections group together requirements based on the stage of onboarding they belong to, and objectives they pursue. The graph in C shows them in relation to the motivation level of the user, according to the model proposed by Hulick in [1]. Keeping momentum is fundamental during the initial phases in which the motivation increases step-wisely with a clear feeling of progress and victory, until reaching registration and up-sell.

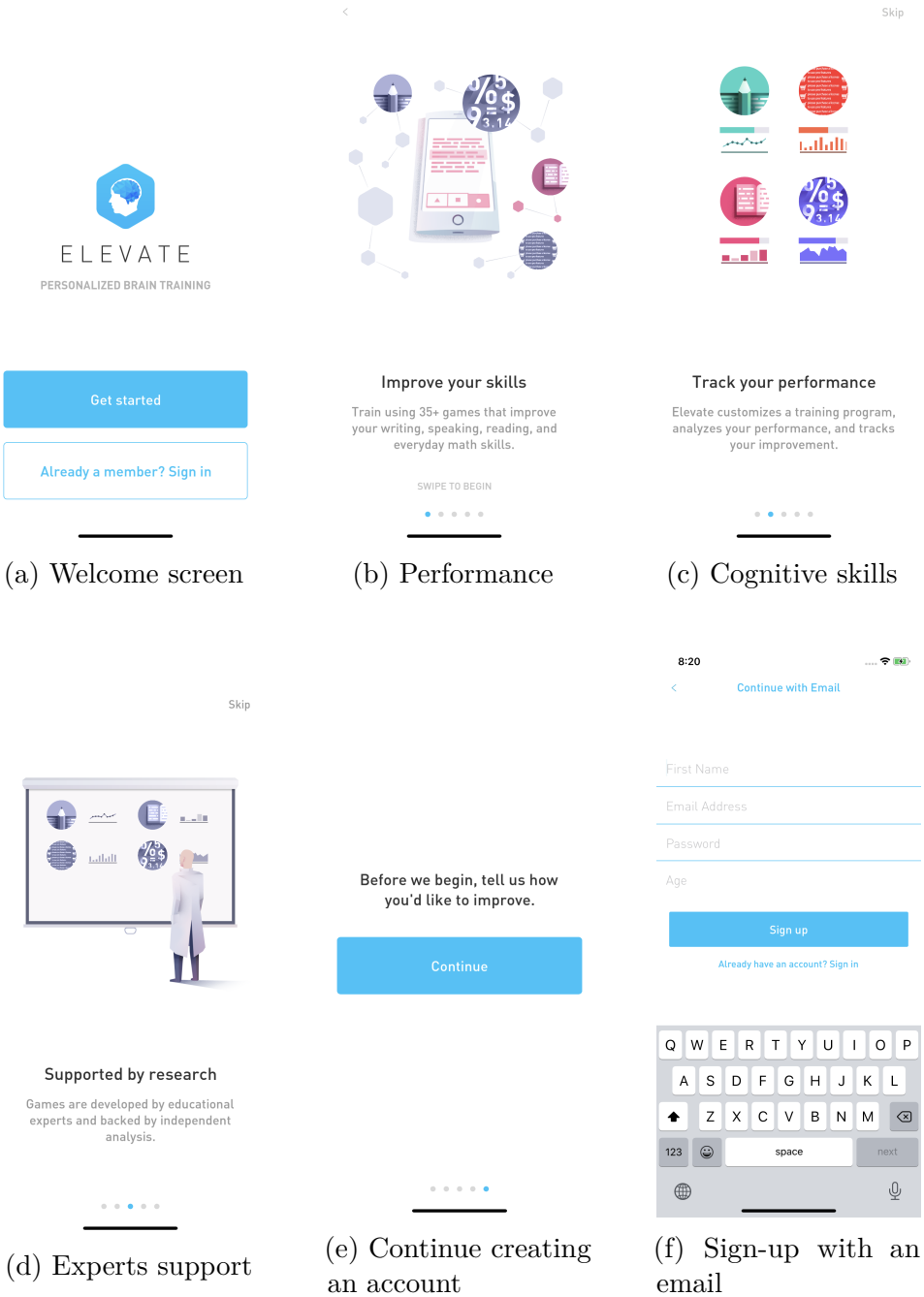
From that moment on, motivation has to be kept on a high level during the first training session, in order to push the user to return on the following day. Occasionally, when the user leaves after trying the product, a new onboarding is needed to re-create motivation and win the user back.

The list of requirements for this project includes:

- **Onboarding pitch**
  - Faster and clearer onboarding pitch flow
    - Returner-friendly flow
    - Trial pitch card
- **Sign-up**
  - New Single-Sign-On options for smoother registration
    - Sign in with Apple
    - Google SignIn
  - Less friction points for data collection
    - Allow an empty first name in sign-up with email
    - Remove last name collection from sign-up with email
- **Up-sell**
  - More clarity around free trial and paid version
    - Change text for the start trial button
- **First training session**
  - Engagement and fun
    - Add a training streak button in the Training tab
  - Communication about scores and game mechanics
    - New messages for progress and high scores
  - Easier day-one gameplay
    - Easier game completion thresholds
- **Re-onboarding**
  - Attract churned users with new onboarding
    - Win-back offers

3.2 Onboarding flow

3.2.1 Returner-friendly onboarding flow



(a) Welcome screen (b) Performance (c) Cognitive skills

(d) Experts support (e) Continue creating an account (f) Sign-up with an email

Figure 12: Onboarding flow re-design

This change involves reorganizing several screens in the onboarding flow to improve the overall organizations and especially the experience for users who are logging back

into the app (e.g., after uninstalling and reinstalling, or after using Elevate on a new device).

Returning users do not need to go through the whole onboarding pitch about what the app is and what benefits it brings, so the welcome screen was modified to include the choice between starting with a new account and logging in with an existing one. This, of course, removes this screen from the swipable pages of the pitch. The skip button in the top-right corner is delayed to the second card of the pitch in one of the two variants, while it is available from the welcome screen in the other one.

In the first card of the onboarding pitch, a bottom text invites the user to swipe to begin his journey with the app. Its text and its position next to the dots of the pager try to emphasize the progression of small steps the user has to perform to get started.

The screen that was once the choice between beginning a new account creation process and logging in now only lets the user proceed with sign-up. But, rather than using the term "Begin", the button copy was changed to "Continue" to put again emphasis on the succession of steps in the process. Once at this point, the user is not beginning, because he already went through the pitch cards, but he is rather continuing the journey.

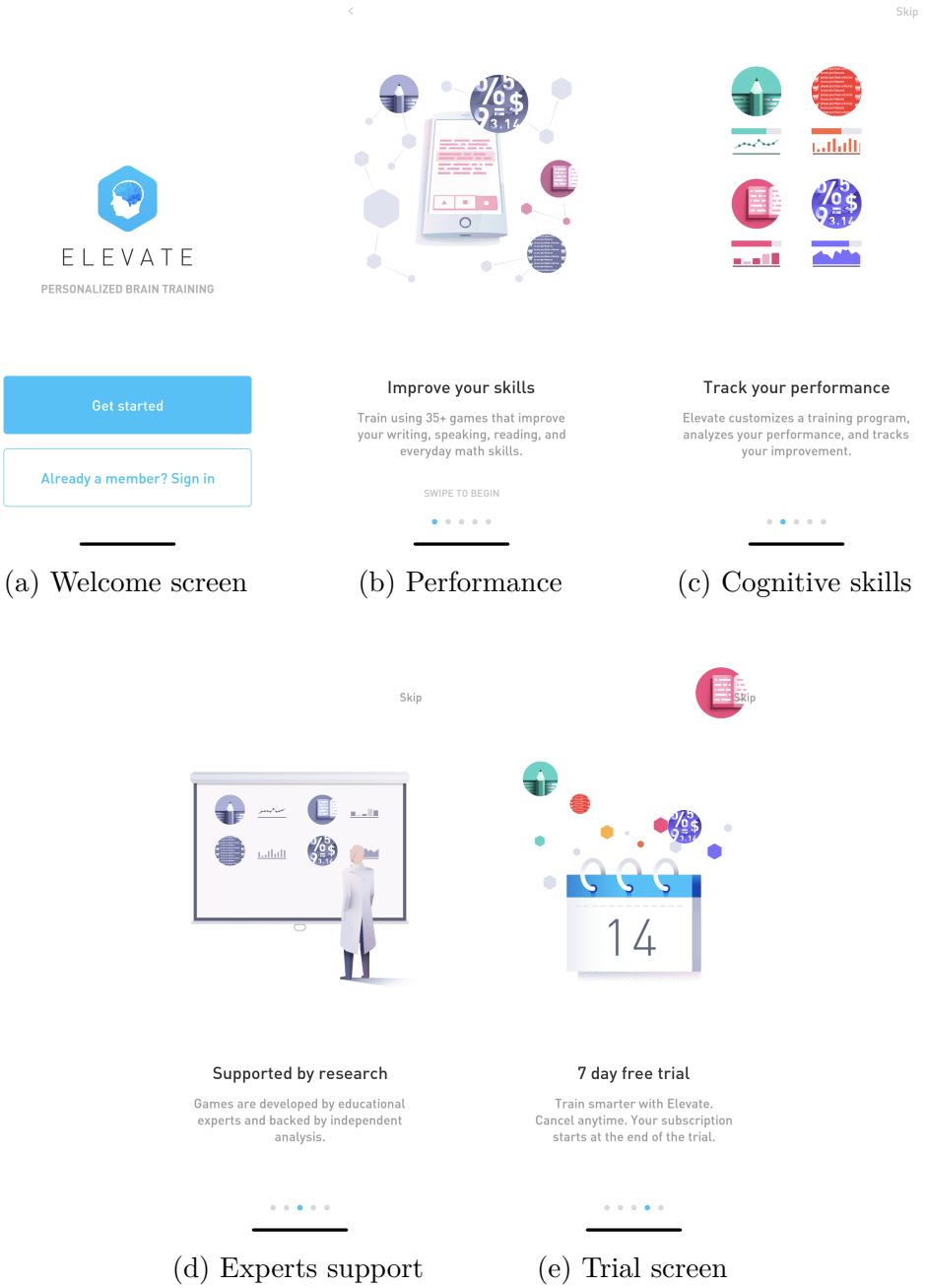
In a large-scale analysis of websites homepages, Nielsen [83] has empirically proved an overall preference for the usage of terms Sign-in and Sign-out over Log-in and Log-out. This motivates the choice to rephrase the bottom button in the sign-up with email screen that proposes to use an existing account: the button copy has changed from "Already have an account? Log in" to "Already have an account? Sign in".

This is a safe-guard test and therefore there is no expectation for any positive metric growth. Accordingly there is no specific hypothesis for this test. The objective is to ship one of the two returner-friendly variants.

The variants of the experiment are:

- **control**: 33.3% split. Control group, old flow.
- **redesign_static_skip**: 33.3% split. Treatment group with returner-friendly flow and static skip button appearing on the welcome screen.
- **redesign_delayed_skip**: 33.3% split. Treatment group with returner-friendly flow and skip button delayed to the second pitch card.

3.2.2 Trial screen in onboarding pitch



(a) Welcome screen (b) Performance (c) Cognitive skills

(d) Experts support (e) Trial screen

Figure 13: Trial screen in onboarding pitch

A new card is added at the end of the onboarding pitch, in order to introduce the possibility to get started with a free trial, and subscribe automatically when this expires. This addition addresses all those complaints from users about the app not being transparent about in-app purchases before asking for sensitive data necessary for the creation of an account.

The hypothesis of the experiment is:

- If we introduce a trial pitch card
- Then fewer users will register but more will subscribe and our rating will improve
- Because users will no longer be frustrated with having to get through onboarding before they learn there is a trial.

The variants of the experiment are:

- **no**: 50% split. Control group, does not show the trial card in the pitch.
- **yes**: 50% split. Treatment group, shows the pitch trial card.

3.3 Sign-up

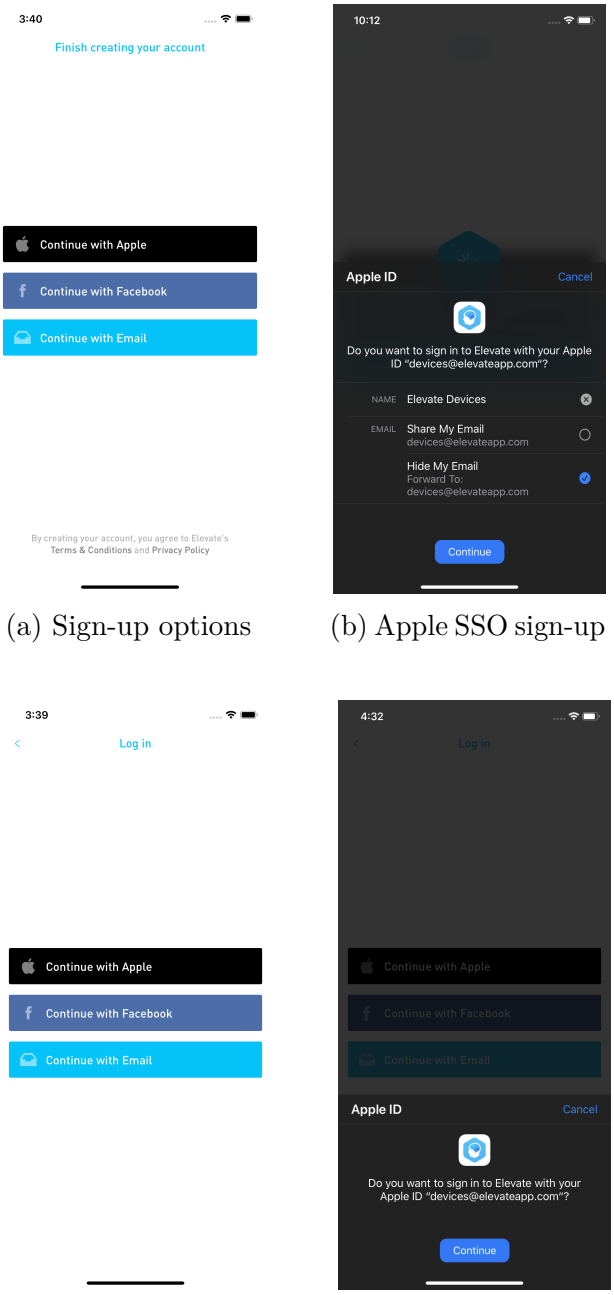
After creating hype and awareness about the product, the user should arrive on the sign-up page with a clear intention to create an account and link his personal information to the app.

This step is crucial for two main reasons:

- Users are more and more worried about deceptive uses of their private data. It is thus fundamental to only ask for information that are really needed, and to do that in a transparent way, in order for the user to understand why he has to provide those information.
- This process has to be fast. After capturing the attention of the user, the app should aim at bringing him to action in as little time as possible. In Elevate's case, this means get to the first training session.

The interventions performed on this step address both points in a complementary way. To increase transparency I analyzed the removal of some constraints on the data the user has to provide. To increase speed I analyzed the benefits of providing access to the most common Single Sign-On architectures.

3.3.1 Sign in with Apple



(a) Sign-up options (b) Apple SSO sign-up

(c) Sign-in options (d) Apple SSO sign-in

Figure 14: Use of Sign in with Apple for sign-in and sign-up

Sign in with Apple [84] is a new Single Sign-on solution from Apple that allows users to sign in to apps and websites with their Apple ID. Differently than other social logins, Sign in with Apple claims to provide a more privacy-focused system that limits the amount of information that users are required to share. For developers, Sign in with Apple is a way of engaging users with a quick, one-tap experience. Superior

security is guaranteed through two-factor authentication and fraud detection.

The service comes with a set of APIs in Swift/Objective-C for iOS developers, as well as in JavaScript, for web-based implementation on other platforms, including Android or Windows.

Apple ID information are fetched locally when using an Apple device where the user is signed in to iCloud with their Apple ID. For other platforms, the user is prompted to enter his Apple ID credentials in a secure, Apple-hosted web page.

The quick interaction lets the user review relevant information and decide whether to share a name and his real email. In fact, users can choose to hide their real email from developers and only share a private relay email address automatically generated by Apple, that will forward all communications received to the real account without revealing it. Each relay address is unique to the user and to the developer, so it cannot be used for tracking a user across different apps or matching with other profile information tied to a personal email address. The user can turn off their relay address for a given developer at any time, making following email bounce back to the developer.

Two-factor authentication is performed on Apple devices with Face ID, or Touch ID. On other platforms, this is achieved with a verification code on the first sign-in from a new device or browser.

After this first interaction, any subsequent visits to an app can be handled on device without sharing any additional information with Apple. The app can call a local refresh API to confirm that the user is still securely signed in to iCloud on the device and allow the user to continue using the app seamlessly without ever reaching out to Apple's servers or sharing any additional information.

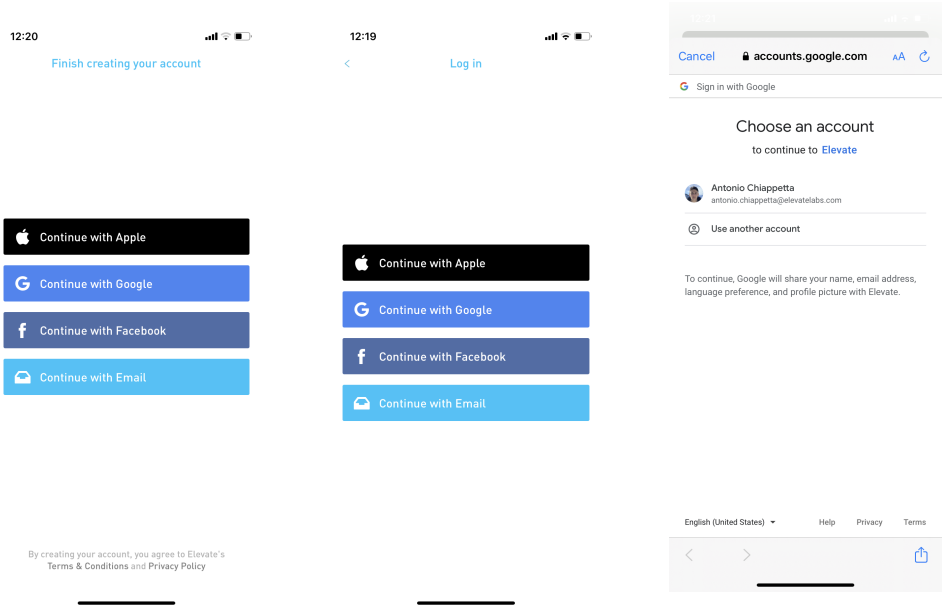
Apple uses data gathered during the creation of the Apple ID account and recent account activity to provide developers with a score indicating the level of confidence about the user being real, in an effort to reduce fraud, scripted account creation. Developers can incorporate this information into any existing anti-fraud systems they currently use to help determining about how to handle a new customer.

Users can easily review the information they shared through Sign in with Apple from their Apple ID settings, as well as turn off their private relay email address for a particular, or stop using their Apple ID with the app completely.

The adoption of Sign in with Apple became mandatory for App Store updates [85] as of June 30th, 2020, for all apps offering the possibility to set up the user's primary account using a third-party or social login services - such as Facebook Login, used in Elevate at the time of starting this project, or Google Sign-In, implemented as part of the project and detailed in the next paragraph. This made it mandatory for Elevate to adopt it, and unnecessary any A/B test.

The feature has then been added to the sign-up options screen and to the sign-in options screen. It activates automatically when reaching these screens on Apple devices, if the device already authorized the use of Sign in with Apple for Elevate in the past.

3.3.2 Google Sign-In



(a) Sign-up options (b) Sign-in options (c) Google SSO sign-in

Figure 15: Use of Google Sign-in for sign-in and sign-up

Google Sign-In [86] is a secure authentication system that reduces the burden of login for your users, by enabling them to sign in with their Google Account—the same account they already use with Gmail, Play, and other Google services.

Prior to this project, Google Sign-In was only used in the Android version of the application, but not on iOS. Analysis on Looker proved that a significant majority of the users on Android (65 %) use it, so an A/B experiment was used to evaluate its addition to iOS.

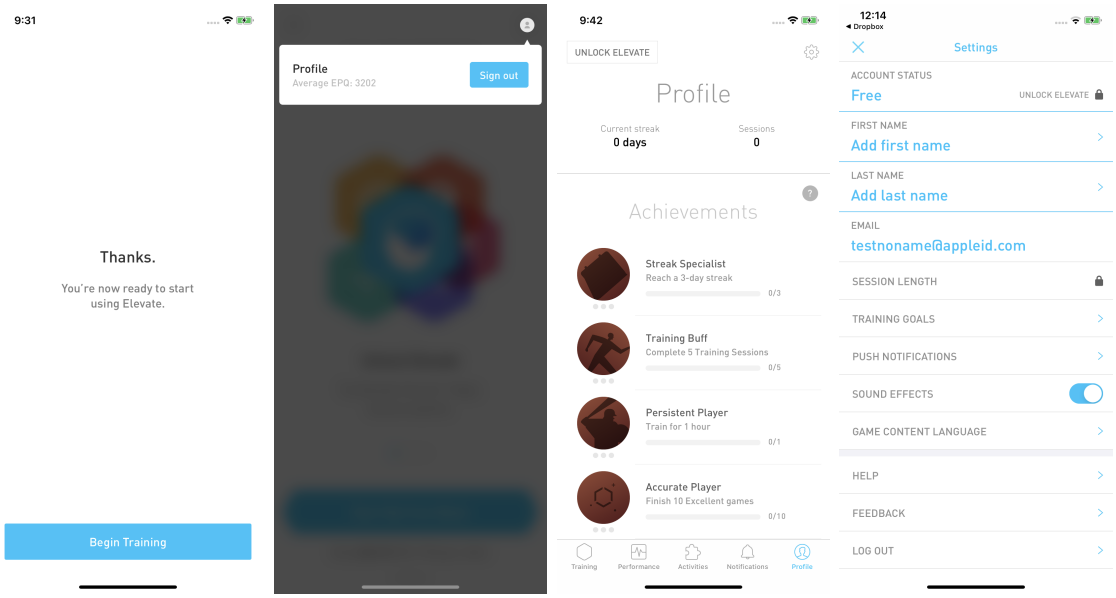
The hypothesis of the experiment is:

- If we add Google Sign-In to the sign-in and sign-up options on iOS
- Users that are used to sign-in to their apps with this system will be incentivized to do it easily also on Elevate
- Thus increasing the sign-up rate
- And making sign-in easier for returning users

The variants of the experiment are:

- **control_no_google_sso**: 50 % split. Control group, does not show Google Sign-In on iOS.
- **variant_adds_google_sso**: 50 % split. Treatment group, does show Google Sign-in on iOS.

3.3.3 Allow an empty first name



(a) Begin training (b) Up-sell log-out (c) Profile (d) Settings

Figure 16: Registration and profile without a first name

Previously to this project, the sign-up option with an email forced the user to enter a non-empty first name. This is then used in a few points in the app:

- Welcoming the user at the end of onboarding.
- When the user tries to log out on the up-sell screen.
- On top of the profile screen, above the streak statistics and achievements.
- In profile settings, where the user can change his first name.

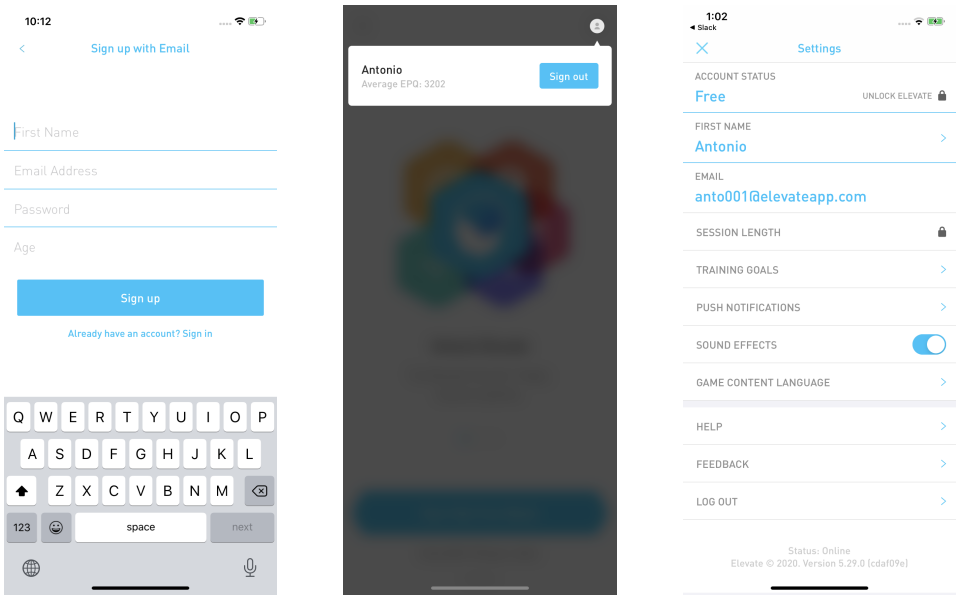
Apart from the app, the first name is used by the marketing team to refer to the user in email communications. It also helps customer support find users when they register with multiple emails and want to remember which account they were paid subscriber with.

However, the introduction of Sign in with Apple posed a problem about the mandatory use of a first name, since it allows it to empty. This made it impossible for Elevate to keep relying on the presence of a first name among the information sent to the server for registration.

At the same time, this did not seem to be a huge deal. The app can use a placeholder for a generic "Profile", while the marketing communications can just avoid using a name to address the customer. For customer support, the use case mentioned before happens quite rarely.

So, the app was refactored to allow it to work with or without a first name. This change was not A/B tested because forced by the introduction of Apple's SSO.

3.3.4 Remove the last name from sign-up with email



(a) Sign-up (b) Up-sell log-out (c) Settings

Figure 17: Registration and profile without a last name

As with the first name, previously to this project, the sign-up option with an email forced the user to enter a non-empty last name. This is then used in a few points in the app:

- When the user tries to log out on the up-sell screen
- In profile settings, where the user can change his last name

Apart from the app, the last name is used by the marketing team to refer to the user in email communications. It also helps customer support find users when they register with multiple emails and want to remember which account they were paid subscriber with.

However, the removal of the last name from the sign-up form was triggered directly by a request from Apple to App Store app developers, in order to make registration flows easier and more transparent. The removal of this element of friction creates additional trust for the user when it comes to sharing his data. Moreover, many users in the First Impressions usability study mentioned uncertainty about why a gaming app should need this kind of information.

As with the first name, and for the same reasons explained in the previous paragraph, the absence of a last name is not so problematic for marketing communications and customer support.

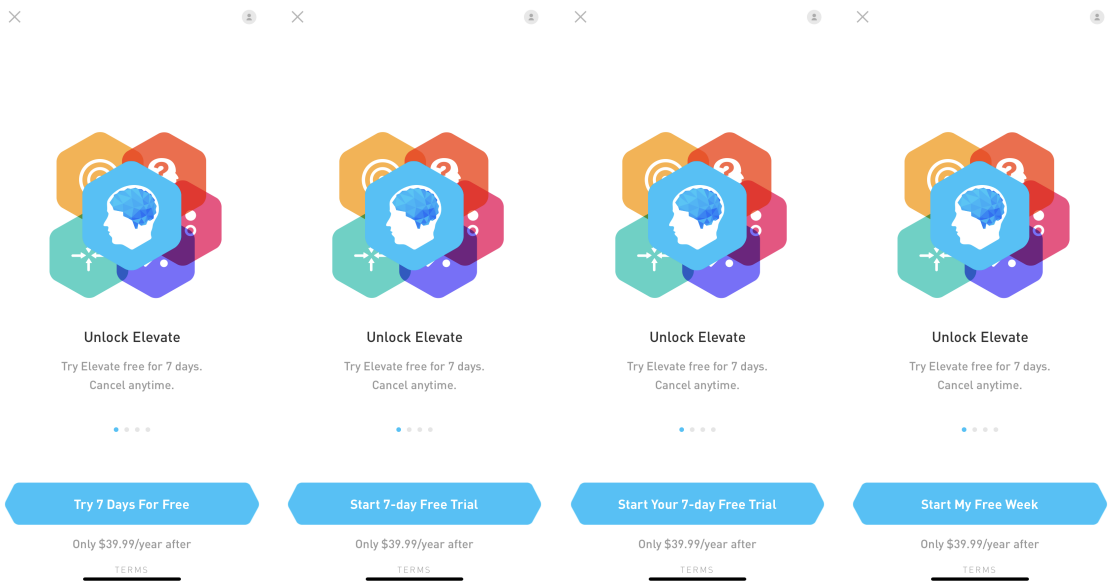
Thus, the last name has been removed from the sign-up with email screen. As a consequence, it does not show up anymore in the log-out option on the up-sell screen, and in the settings. However, the underneath logic of the app still supports last names for two main reasons:

- Backwards last name support for past users, for which it would be oddly non-transparent to see their last name gone from the app, when they are perfectly aware that the developer owns that information.
- To keep using the marketing and customer support benefits of last names for those users that will register with a third-party SSO, and for which it is easier to ask for a last name without introducing any friction in the registration flow.

This change was not A/B tested because forced by a guideline coming directly from Apple.

3.4 Up-sell

3.4.1 Change copy for the start trial button



(a) Control - Try x days for free (b) Variant - Start x days free trial (c) Variant - Start your x days free trial (d) Variant - Start my free week

Figure 18: Up-sell trial button copy changes

Observation of other apps' behavior has led Elevate to different changes in the way the paid subscription gets presented to users. Recently, the introduction of a period of free trial has definitely increased the conversion to pro users and reduced churn on the up-sell page, where users often arrive with a bad feeling because probably they didn't expect they had to pay to get the full product.

This change to the copy for the trial button text aims at trying slightly different variations in the way of conveying the message, taking inspiration by competitor apps or simply apps with a similar, subscription-based, business model.

The hypothesis of the experiment is:

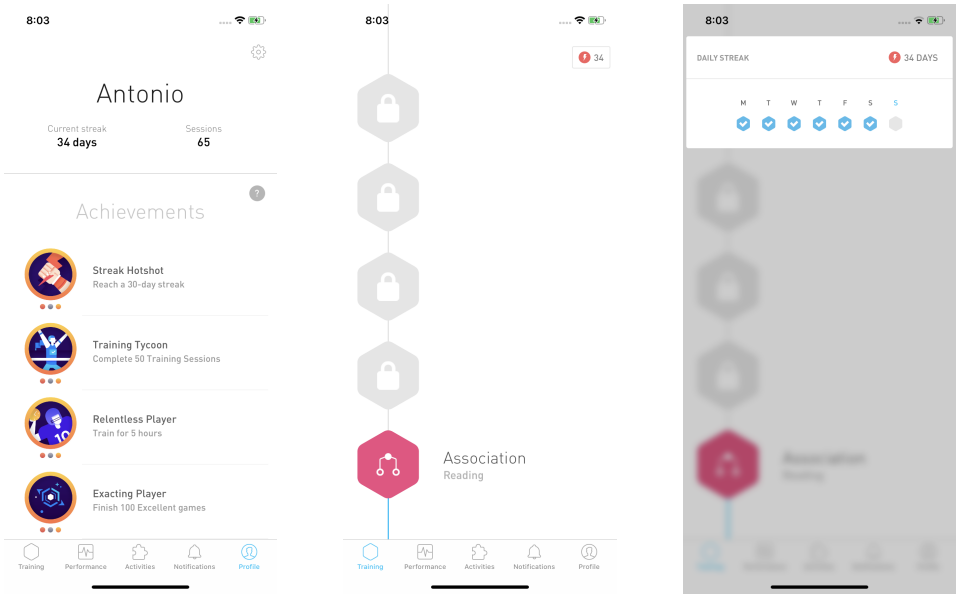
- If we change the text of the start trial button to something that appeals users more
- Users will be more willing to subscribe

The variants of the experiment are:

- **control_try_7_days_for_free**: 25% split. Control group, shows the "try 7 days for free" message.
- **variant_start_7_day_free_trial**: 25% split. Treatment group showing the "start 7-day free trial" message.
- **variant_start_my_free_week**: 25% split. Treatment group showing the "start your 7-day free trial" message.
- **variant_start_your_7_day_free_trial**: 25% split. Treatment group showing the "start my free week" message.

3.5 First training session

3.5.1 Add a training streak button in the Training tab



(a) Streak in profile tab

(b) Streak in training tab

(c) Streak more info view

Figure 19: Training streak button in training tab

The idea of showing a streak of consecutive training days is common to many apps related to exercise, whether that is physical or mental. You can find this concept related to running, workouts, learning a language, and of course brain training. And

that is why Elevate already included a summary of your recent training performance on the profile tab, showing how many hours you trained and what is your current training streak.

However, the research conducted with Elevate users showed they usually identity their experience with Elevate almost entirely with their recommended daily training session, and rarely end up in other parts of the app. This created a need to move this motivation element towards the training tab, in order for the user to see it more often, and thus be more motivated to finish the daily session in order to keep increasing the streak.

This is especially important for new users in the app. Being motivated by challenges such as keeping a long training streak is among the actions aiming at making him stick to the product in the first days, and hopefully subscribe at the end of a trial week.

As an A/B experiment, I implemented a training streak button in the training tab, that instantly reminds the user about his training streak when opening the app and landing on the training screen. Additionally, a click on this button shows the trend of his training sessions across the current week, in a similar fashion to what he sees every time the completes the daily session.

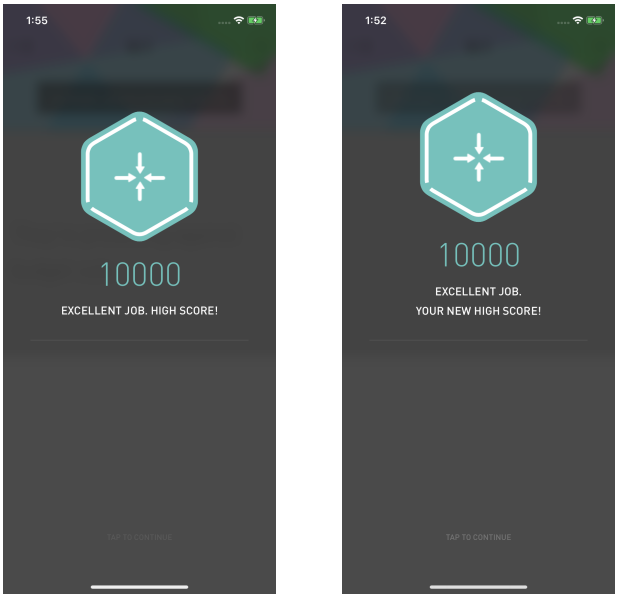
The hypothesis of the experiment is:

- If we add a daily streak counter on their training screen
- Then we would see higher rates of training and therefore greater stickiness and lower churn
- Because we would give people a way to stay motivated using the mechanism of streaks

The variants of the experiment are:

- **no**: 50% split. Control group, does not add the training tab streak widget
- **yes**: 50% split. Treatment group, adds the training tab streak widget

3.5.2 Improved communication about progress and high scores



(a) High score celebration text

(b) Your new high score celebration text

Figure 20: High score celebration text experiment

Many first-time users are confused when they complete a game with an excellent performance and Elevate says they got a high score. What getting a high score in Elevate terms means is that the user just hit his personal best score at that game. No comparisons is made to other users playing the same game.

However, research showed that on day-one users are not fully aware that their scores will not be compared to other users, and they might think that a high score refers to a general leaderboard of all users playing that game. This can lead to confusion and loss of trust as the user may think it is improbable he got the best score of all users at a game after playing it only once, or that not many users must be playing the game for him to get the highest score so quickly.

This considerations lead to the execution of an A/B test with two variants for the high score celebration text: the control group kept seeing the old "HIGH SCORE!" text, while the treatment group started seeing a new "YOUR NEW HIGH SCORE!" text.

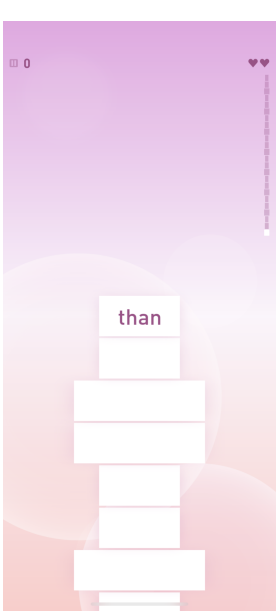
The hypothesis of the experiment is:

- If we change our “high score” messaging to “your high score”
- Then we will remove first day session confusion and increase engagement
- Because it will make the experience and the game feedback more understandable and, therefore, motivating.

The variants of the experiment are:

- **control_high_score**: 50 % split. Control group, shows the old "high score" message.
- **variant_your_new_high_score**: 50 % split. Treatment group, shows the new "your new high score" message.

3.5.3 Easier game completion thresholds



(a) Processing with 2 lives for the control group

(b) Processing with 4 lives for the treatment group with a 50% lower failure rate

Figure 21: Easier game completion thresholds experiment

The research done on first-day experiences for new users showed difficulties in completing the first training session that was sometimes related to a high-fail rate for a game.

Managing the effectiveness of the fail-rate and the completion threshold is complicated because the game has to be difficult enough to be challenging and create stimulus, but easy enough to not create frustration. On the first day, users have very scarce knowledge of the game mechanics and for this reason it is even more important to avoid frustration related to failure.

The two games used in the first training session that show higher failure rates on day-one compared to their average are Processing and Equivalence. An A/B experiment was used to test a 50 % and a 90 % lower failure rate on day-one for these two games.

The hypothesis of the experiment is:

- If we make it easier to complete a game after onboarding

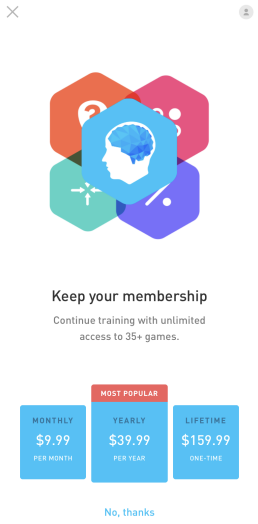
- Users will be more willing to complete the training session and not drop before
- And consequently they will return to play in the following days.

The variants of the experiment are:

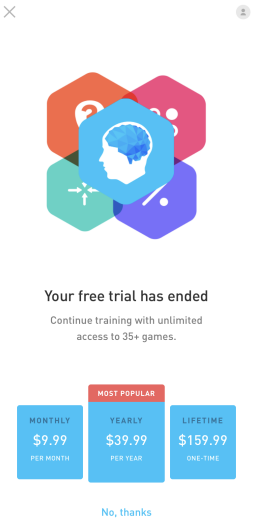
- **control_fail_rate_unchanged**: 33 % split. Control group, uses the same failure rate as usual for Processing and Equivalence.
- **variant_reduce_fail_rate_by_50_percent**: 33 % split. Treatment group using a 50 % lower failure rate compared to the usual failure rate for Processing and Equivalence.
- **variant_reduce_fail_rate_by_90_percent**: 33 % split. Treatment group using a 90 % lower failure rate compared to the usual failure rate for Processing and Equivalence.

3.6 Re-onboarding

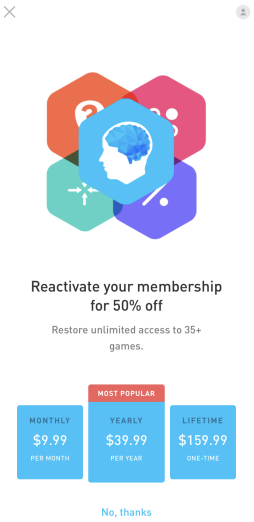
3.6.1 Win-back offers



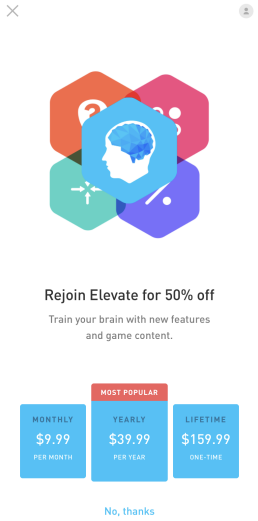
(a) Win-back offer control for triggers 1 and 3



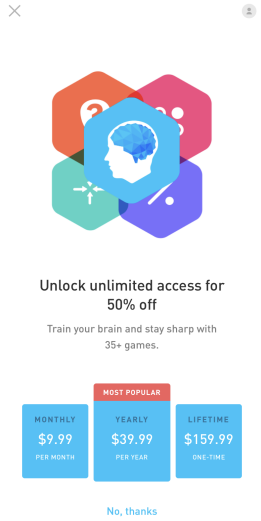
(b) Win-back offer variant for trigger 1



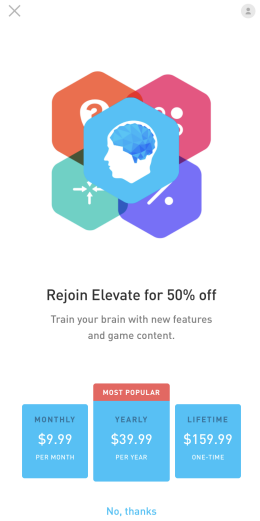
(c) Win-back offer variant for trigger 3



(d) Win-back offer variant for trigger 4



(e) Win-back offer variant for trigger 5



(f) Win-back offer variant for trigger 6

Figure 22: Win-back offers

A common practice in many mobile apps implementing a subscription-based business model is to try to win-back old customers by offering them one-time only discounts on a new subscription.

These discounts can take different forms, according to when in the lifetime of the customer's experience with the app they are shown. In apps providing a free trial, usually this process is activated with different messages and price offers depending on whether the customer only went through a trial or finished a paid subscription.

Despite not involved in the first-day experience, as most of the solutions proposed in this chapter, this kind of change applied to a constant re-onboarding of users. If they keep using the app but are not yet, or not anymore, willing to pay for it, presenting such a discount on app opening proves to be an effective way of reactivating from the beginning the paid experience with the service.

Prior to this project, Elevate was already using this option, but only with respect to the first app opening after a subscription expired. The idea in this case instead is to re-purpose the offers for other occasions.

The introduction of these win-back offers in Elevate has been implemented with an A/B test, in order to test two main possible flows handled by back-end triggers:

- The control group was presented with the same screen used previously after the end of a subscription, but now in two occasions:
  - Trigger 1: End of a free trial
  - Trigger 3: End of a subscription
- The treatment group was presented with different messages depending on the moment when the screen was shown, adding two more options to the cases covered for the control group:
  - Trigger 1: End of a free trial
  - Trigger 3: End of a subscription
  - Trigger 4: User that unsubscribed long ago
  - Trigger 5: User that unsubscribed recently
  - Trigger 6: User that ended a trial long ago

4 Results

This section discusses the results of A/B tests and other changes applied to the Elevate app with quantitative analysis of users' behavior with the new features as opposed to users' past behavior in the same sections of the onboarding flow, with an attention to the success metrics previously defined as inputs to the northstar metric for the Elevate product and the goals of the project.

4.1 Evaluation of developments on the Elevate app

4.1.1 Onboarding flow

The changes to the onboarding flow include a restyling of the flow to make sign-in easier for returning users, and the introduction of a card in the onboarding pitch to advertise the existence of a free trial.

The following tables show the performances of the two variants for the returner-friendly onboarding flow experiment. The experiment does not appear to have had significant impacts on any metric measured. If anything, the variant with the static skip appears to have improved sign-up rate, but only by a small amount.

	Experiment Analysis **Metric**	Experiment Analysis **Num Total A**	Experiment Analysis **Num Total B**	Experiment Analysis **Num Converted A**	Experiment Analysis **Num Converted B**	Experiment Analysis **Diff Absolute**	Experiment Analysis **Diff Relative**	Experiment Analysis **Result**	Experiment Analysis **Value A**	Experiment Analysis **Value B**
1	signup_rate	174,763	173,643	119,771	119,576	0.33%	0.48%	LIFT	69%	69%
2	first_event_retention_day_1	119,709	119,511	30,919	30,907	0.03%	0.13%	NO CHANGE	26%	26%
3	retention_day_1	119,702	119,505	29,196	29,224	0.06%	0.26%	NO CHANGE	24%	24%
4	conversion_trial_started_6_weeks	119,418	119,223	14,573	14,628	0.07%	0.54%	NO CHANGE	12%	12%
5	conversion_trial_started_1_weeks	119,734	119,538	14,187	14,232	0.06%	0.48%	NO CHANGE	12%	12%
6	first_event_retention_day_7	119,709	119,511	13,393	13,163	-0.17%	-1.55%	NO CHANGE	11%	11%
7	retention_day_7	119,658	119,463	13,279	13,010	-0.21%	-1.87%	NO CHANGE	11%	11%
8	trial_start_to_not_churned_1_day	13,303	13,378	10,874	10,853	-0.62%	-0.75%	NO CHANGE	82%	81%
9	conversion_any_converted_6_weeks	119,418	119,223	5,894	5,874	-0.01%	-0.18%	NO CHANGE	5%	5%
10	conversion_any_converted_3_weeks	119,629	119,428	5,692	5,710	0.02%	0.49%	NO CHANGE	5%	5%
11	first_event_retention_day_30	119,709	119,511	5,645	5,408	-0.19%	-4.04%	DROP	5%	5%
12	conversion_any_converted_2_weeks	119,678	119,482	5,610	5,611	0.01%	0.18%	NO CHANGE	5%	5%
13	retention_day_30	119,467	119,265	5,559	5,361	-0.16%	-3.40%	NO CHANGE	5%	4%
14	conversion_trial_start_to_convert_6_weeks	14,573	14,628	5,411	5,409	-0.15%	-0.41%	NO CHANGE	37%	37%
15	conversion_trial_start_to_convert_3_weeks	14,437	14,500	5,227	5,263	0.09%	0.25%	NO CHANGE	36%	36%
16	conversion_trial_start_to_convert_2_weeks	14,355	14,422	5,154	5,183	0.03%	0.10%	NO CHANGE	36%	36%
17	conversion_purchase_to_unchurned_3_weeks	14,778	14,799	4,524	4,467	-0.43%	-1.40%	NO CHANGE	31%	30%
18	conversion_purchase_to_unchurned_4_weeks	14,831	14,862	4,471	4,388	-0.62%	-2.06%	NO CHANGE	30%	30%
19	conversion_purchase_to_unchurned_6_weeks	14,914	14,929	4,356	4,269	-0.61%	-2.10%	NO CHANGE	29%	29%
20	conversion_trial_start_to_convert_4_weeks_and_not_churned	14,490	14,562	4,118	4,067	-0.49%	-1.73%	NO CHANGE	28%	28%
21	first_event_retention_day_60	119,709	119,511	3,538	3,406	-0.11%	-3.57%	NO CHANGE	3%	3%
22	retention_day_60	119,029	118,837	3,474	3,361	-0.09%	-3.10%	NO CHANGE	3%	3%
23	subscriber_retention_day_60	5,524	5,469	822	798	-0.29%	-1.94%	NO CHANGE	15%	15%
24	conversion_nontrial_converted_6_weeks	119,418	119,223	515	498	-0.01%	-3.14%	NO CHANGE	0%	0%
25	conversion_nontrial_converted_3_weeks	119,629	119,428	491	476	-0.01%	-2.89%	NO CHANGE	0%	0%
26	conversion_nontrial_converted_2_weeks	119,678	119,482	481	455	-0.02%	-5.25%	NO CHANGE	0%	0%

Figure 23: Metrics observed during the onboarding flow redesign experiment for the variant with a static skip

	Experiment Analysis **Metric**	Experiment Analysis **Num Total A**	Experiment Analysis **Num Total B**	Experiment Analysis **Num Converted A**	Experiment Analysis **Num Converted B**	Experiment Analysis **Diff Absolute**	Experiment Analysis **Diff Relative**	Experiment Analysis **Result**	Experiment Analysis **Value A**	Experiment Analysis **Value B**
1	signup_rate	174,738	174,681	119,746	120,238	0.3%	0.44%	NO CHANGE	69%	69%
2	first_event_retention_day_1	119,684	120,183	30,901	30,947	-0.07%	-0.27%	NO CHANGE	26%	26%
3	retention_day_1	119,677	120,179	29,177	29,359	0.05%	0.20%	NO CHANGE	24%	24%
4	conversion_trial_started_6_weeks	119,393	119,894	14,601	14,732	0.06%	0.48%	NO CHANGE	12%	12%
5	conversion_trial_started_1_weeks	119,709	120,212	14,210	14,292	0.02%	0.16%	NO CHANGE	12%	12%
6	first_event_retention_day_7	119,684	120,183	13,378	13,459	0.02%	0.19%	NO CHANGE	11%	11%
7	retention_day_7	119,633	120,145	13,264	13,292	-0.02%	-0.22%	NO CHANGE	11%	11%
8	trial_start_to_not_churned_1_day	13,319	13,430	10,890	10,925	-0.42%	-0.51%	NO CHANGE	82%	81%
9	conversion_any_converted_6_weeks	119,393	119,894	5,904	5,941	0.01%	0.21%	NO CHANGE	5%	5%
10	conversion_any_converted_3_weeks	119,604	120,097	5,700	5,734	0.01%	0.18%	NO CHANGE	5%	5%
11	first_event_retention_day_30	119,684	120,183	5,641	5,502	-0.14%	-2.87%	NO CHANGE	5%	5%
12	conversion_any_converted_2_weeks	119,653	120,152	5,618	5,641	0.0%	-0.01%	NO CHANGE	5%	5%
13	retention_day_30	119,442	119,945	5,554	5,475	-0.09%	-1.84%	NO CHANGE	5%	5%
14	conversion_trial_start_to_convert_6_weeks	14,601	14,732	5,431	5,472	-0.05%	-0.14%	NO CHANGE	37%	37%
15	conversion_trial_start_to_convert_3_weeks	14,463	14,582	5,246	5,291	0.01%	0.03%	NO CHANGE	36%	36%
16	conversion_trial_start_to_convert_2_weeks	14,380	14,488	5,173	5,216	0.03%	0.08%	NO CHANGE	36%	36%
17	conversion_purchase_to_unchurned_3_weeks	14,795	14,884	4,538	4,479	-0.58%	-1.89%	NO CHANGE	31%	30%
18	conversion_purchase_to_unchurned_4_weeks	14,849	14,954	4,481	4,408	-0.7%	-2.32%	NO CHANGE	30%	29%
19	conversion_purchase_to_unchurned_6_weeks	14,933	15,035	4,366	4,303	-0.62%	-2.11%	NO CHANGE	29%	29%
20	conversion_trial_start_to_convert_4_weeks_and_not_churned	14,517	14,651	4,136	4,101	-0.5%	-1.75%	NO CHANGE	28%	28%
21	first_event_retention_day_60	119,684	120,183	3,543	3,432	-0.1%	-3.54%	NO CHANGE	3%	3%
22	retention_day_60	119,004	119,473	3,477	3,395	-0.08%	-2.74%	NO CHANGE	3%	3%
23	subscriber_retention_day_60	5,532	5,554	827	816	-0.26%	-1.72%	NO CHANGE	15%	15%
24	conversion_nontrial_converted_6_weeks	119,393	119,894	508	499	-0.01%	-2.18%	NO CHANGE	0%	0%
25	conversion_nontrial_converted_3_weeks	119,604	120,097	483	469	-0.01%	-3.30%	NO CHANGE	0%	0%
26	conversion_nontrial_converted_2_weeks	119,653	120,152	473	448	-0.02%	-5.68%	NO CHANGE	0%	0%

Figure 24: Metrics observed during the onboarding flow redesign experiment for the variant with a delayed skip

Given that this was a safe-guard experiment, whose only aim whose to not negatively impact metrics while making sign-in easier for returning users, it feels safe to ship the variant with the static skip.

The next table shows the metrics for the introduction of a trial card in the onboarding pitch.

	Experiment Analysis **Metric**	Experiment Analysis **Variant A**	Experiment Analysis **Variant B**	Experiment Analysis **Variants Count**	Experiment Analysis **Num Converted A**	Experiment Analysis **Num Converted B**	Experiment Analysis **Num Total A**	Experiment Analysis **Num Total B**	Experiment Analysis **Revenue A**	Experiment Analysis **Revenue B**	Experiment Analysis **Diff Absolute**	Experiment Analysis **Diff Relative**	Experiment Analysis **Result**	Experiment Analysis **Value A**	Experiment Analysis **Value B**
1	trial_start_to_not_churned_1_day	no	yes	2	21,284	22,348	26,165	27,687	$0	$0	-0.63%	-0.77%	NO CHANGE	81%	81%
2	subscriber_retention_day_60	no	yes	2	1,594	1,473	10,894	10,727	$0	$0	-0.9%	-6.15%	NO CHANGE	15%	14%
3	signup_rate	no	yes	2	205,300	172,480	292,810	287,505	$0	$0	-10.12%	-14.44%	DROP	70%	60%
4	retention_day_7	no	yes	2	24,058	19,597	205,129	172,323	$0	$0	-0.36%	-3.04%	DROP	12%	11%
5	retention_day_60	no	yes	2	6,352	5,000	204,318	171,311	$0	$0	-0.19%	-6.12%	DROP	3%	3%
6	retention_day_30	no	yes	2	9,919	7,925	204,864	171,977	$0	$0	-0.23%	-4.82%	DROP	5%	5%
7	retention_day_1	no	yes	2	51,856	44,470	205,182	172,390	$0	$0	0.52%	2.07%	LIFT	25%	26%
8	first_event_retention_day_7	no	yes	2	24,316	19,726	205,195	172,397	$0	$0	-0.41%	-3.44%	DROP	12%	11%
9	first_event_retention_day_60	no	yes	2	6,437	5,095	205,195	172,397	$0	$0	-0.18%	-5.79%	DROP	3%	3%
10	first_event_retention_day_30	no	yes	2	10,029	7,971	205,195	172,397	$0	$0	-0.26%	-5.40%	DROP	5%	5%
11	first_event_retention_day_1	no	yes	2	54,719	46,713	205,195	172,397	$0	$0	0.43%	1.61%	LIFT	27%	27%
12	conversion_unchurned_in_4_weeks_before_annual_renewal	no	yes	2	5	7	5	7	$0	$0	0.0%	0.00%	NO CHANGE	100%	100%
13	conversion_trial_started_6_weeks	no	yes	2	28,664	30,135	204,810	171,869	$0	$0	3.54%	25.28%	LIFT	14%	18%
14	conversion_trial_started_1_weeks	no	yes	2	27,911	29,418	205,240	172,426	$0	$0	3.46%	25.46%	LIFT	14%	17%
15	conversion_trial_start_to_convert_6_weeks	no	yes	2	10,672	10,729	28,664	30,135	$0	$0	-1.63%	-4.37%	DROP	37%	36%
16	conversion_trial_start_to_convert_4_weeks_and_not_churned	no	yes	2	7,913	7,920	28,508	29,996	$0	$0	-1.35%	-4.88%	DROP	28%	26%
17	conversion_trial_start_to_convert_3_weeks	no	yes	2	10,341	10,427	28,394	29,899	$0	$0	-1.55%	-4.24%	DROP	36%	35%
18	conversion_trial_start_to_convert_2_weeks	no	yes	2	10,187	10,301	28,266	29,746	$0	$0	-1.41%	-3.91%	DROP	36%	35%
19	conversion_refunded_6_weeks	no	yes	2	675	727	11,725	11,560	$0	$0	0.53%	9.24%	NO CHANGE	6%	6%
20	conversion_refunded_4_weeks	no	yes	2	610	651	11,504	11,378	$0	$0	0.42%	7.90%	NO CHANGE	5%	6%
21	conversion_refunded_3_weeks	no	yes	2	557	602	11,348	11,222	$0	$0	0.46%	9.29%	NO CHANGE	5%	5%
22	conversion_purchase_to_unchurned_6_weeks	no	yes	2	8,395	8,165	29,271	30,516	$0	$0	-1.92%	-6.71%	DROP	29%	27%
23	conversion_purchase_to_unchurned_4_weeks	no	yes	2	8,643	8,457	29,111	30,377	$0	$0	-1.85%	-6.23%	DROP	30%	28%
24	conversion_purchase_to_unchurned_3_weeks	no	yes	2	8,790	8,601	28,997	30,280	$0	$0	-1.91%	-6.30%	DROP	30%	28%
25	conversion_nontrial_converted_6_weeks	no	yes	2	1,121	915	204,810	171,869	$0	$0	-0.01%	-2.73%	NO CHANGE	1%	1%
26	conversion_nontrial_converted_3_weeks	no	yes	2	1,062	863	205,091	172,242	$0	$0	-0.02%	-3.24%	NO CHANGE	1%	1%
27	conversion_nontrial_converted_2_weeks	no	yes	2	1,031	838	205,168	172,339	$0	$0	-0.02%	-3.24%	NO CHANGE	1%	0%
28	conversion_any_converted_6_weeks	no	yes	2	11,725	11,560	204,810	171,869	$0	$0	1.0%	17.49%	LIFT	6%	7%
29	conversion_any_converted_3_weeks	no	yes	2	11,348	11,222	205,091	172,242	$0	$0	0.98%	17.75%	LIFT	6%	7%
30	conversion_any_converted_2_weeks	no	yes	2	11,166	11,073	205,168	172,339	$0	$0	0.98%	18.06%	LIFT	5%	6%
31	average_unrefunded_revenue_per_user_6_weeks	no	yes	2	0	0	204,810	171,869	$432,436	$428,625	$0.38	18.12%	LIFT	$2.11	$2.49
32	average_unrefunded_revenue_per_user_4_weeks	no	yes	2	0	0	205,007	172,135	$424,718	$422,515	$0.38	18.48%	LIFT	$2.07	$2.45
33	average_unrefunded_revenue_per_user_3_weeks	no	yes	2	0	0	205,091	172,242	$416,873	$414,373	$0.37	18.36%	LIFT	$2.03	$2.41

Figure 25: Metrics observed during the experiment introducing a pitch card for the free trial

The most significant metric changes include:

- -14.5% for **Sign-up rate**. As expected, sign-ups dropped as a result of this card appearing early in the user's flow.
- $+25.6\%$ for **Trial starts, 1 week**. Since fewer users came in, those that did converted at higher rates (the denominator here are signed-up users).
- -6.3% for **Purchase-to-unchurned 3 weeks**. We saw a drop in our still-subscribed rate.
- $+18.5\%$ for **Average unrefunded revenue per user 3 weeks**. This increase in average unrefunded revenue is against registration. After accounting for the sign-up drop-off rate, this is statistically insignificant ($+1\%$).

To better understand if there was an impact on App Store/Google Play Store ratings, the following metrics were analyzed, both before and during the experiment:

- Total Number of Ratings
- Average Rating
- Median Rating
- Distribution of Ratings

It is worth noticing that data are limited by the impossibility to distinguish ratings coming from new users, because of privacy-related limitations. As a consequence, the analysis involves all users.

We see that those in the experiment rated the app about 0.52 % higher than those not in the experiment.

Bucket	**Total Ratings**	**Average Ratings**	**Median Ratings**
Pre-Experiment (4/30-5/12/2020)	15666	4.46	5.0
Experiment (5-14-5/26/2020)	13990	4.48	5.0

Table 1: Rating metrics analyzed for the experiment introducing a pitch card for the onboarding trial - 1

Bucket	**Total Ratings**	**Distribution**
Pre-Experiment (4/30-5/12/2020)	15666	4.46
1	188	1.20%
2	110	0.70%
3	381	2.43%
4	2912	18.59%
5	12075	77.08%
Experiment (5-14-5/26/2020)	13990	4.48
1	146	1.04%
2	106	0.76%
3	375	2.68%
4	2488	17.78%
5	10875	77.73%

Table 2: Rating metrics analyzed for the experiment introducing a pitch card for the onboarding trial - 2

When we look at the distribution of the scores, we see 15 % less 1 ratings and 9 % more 3 ratings. To that same end, we then see less 2 ratings (presumably the 1s moving to 2s) and less 4 ratings (presumably the 3s moving to 4s) and when we look at the overall rating changes, we see a minor bump for those in the experiment. Those in the experiment give about 0.52 % more favorable rating.

Rating	**Pre-Experiment (4/30-5/12/2020)**	**Experiment (5-14-5/26/2020)**	**Change**	**Status**
1	1.2%	1.0%	-15.0%	improvement
2	0.7%	0.8%	7.3%	decline
3	2.4%	2.7%	9.3%	improvement
4	18.6%	17.8%	-4.5%	decline
5	77.1%	77.7%	0.8%	improvement

Table 3: Rating metrics analyzed for the experiment introducing a pitch card for the onboarding trial - 3

As expected, a big decline in the sign-up rate was balanced by a lift in the number of registered users who decide to start a trial. However, there was no overall gain in revenue and instead there was a significant drop in the still-subscribed rate. Moreover, there was no clear improvement in the quality of ratings. The conclusion is that the experiment did not succeed.

4.1.2 Sign-up

The changes to the sign-in and sign-up methods in Elevate include the addition of two new SSO options (through Apple and Google), and the removal of some information for registration with an email, in particular the last name was removed, while first name was allowed to be empty.

The two latter changes were implemented because of requests coming from Apple and related to the development of Sign in with Apple. For this reason no particular analysis was executed for them, and their impact is analyzed through the evaluation of Sign in with Apple.

Sign in with Apple was implemented only on iOS, and not as an A/B test, because Apple imposed its mandatory use for apps using other third-parties SSO options. Thus, the analysis focuses on whether the sign up process saw benefits or not after its introduction.

The following chart shows the retention of the onboarding funnel in the first weeks after the release of the future. The chart focuses on all the sign-up options, and shows no big change in either direction on the iOS side. The absence of harm caused by Sign in with Apple reassures also that no bad impact was made by allowing empty first names or removing last names during sign-up with email.

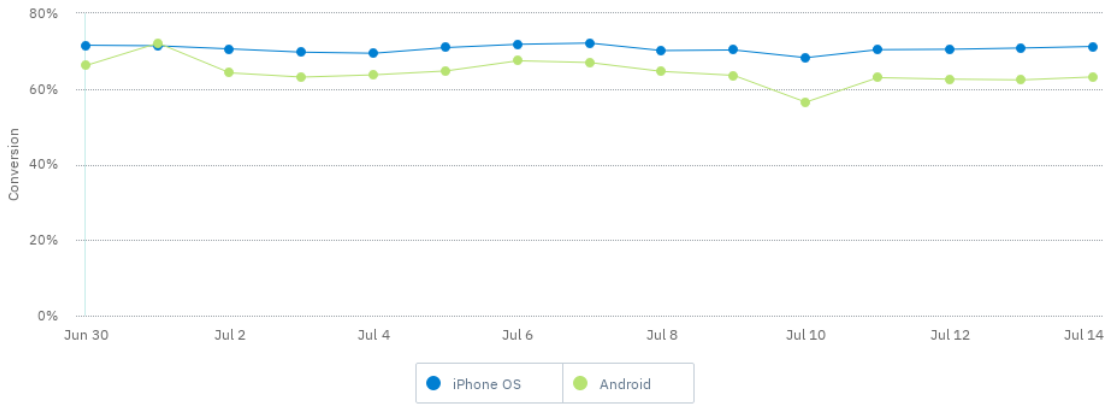


Figure 26: Onboarding funnel conversion rates after the introduction of Sign in with Apple

In the next chart there is a comparison of new-to-trial start rates in the same time period. No strong sign of change on the iOS side if we consider the overall rate across all sign-up options, since values keep oscillating around 17-18%. However, a focus on accounts created with Sign in with Apple shows higher rates, oscillating around 21-22%.

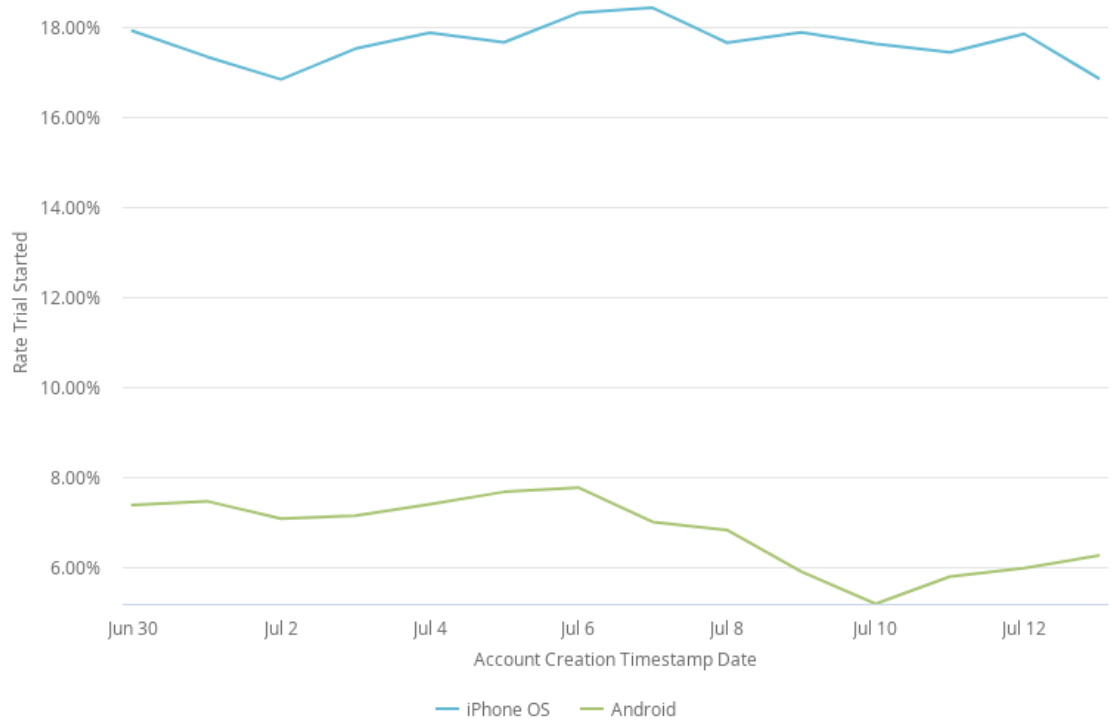


Figure 27: New-to-trial start rates after the introduction of Sign in with Apple overall

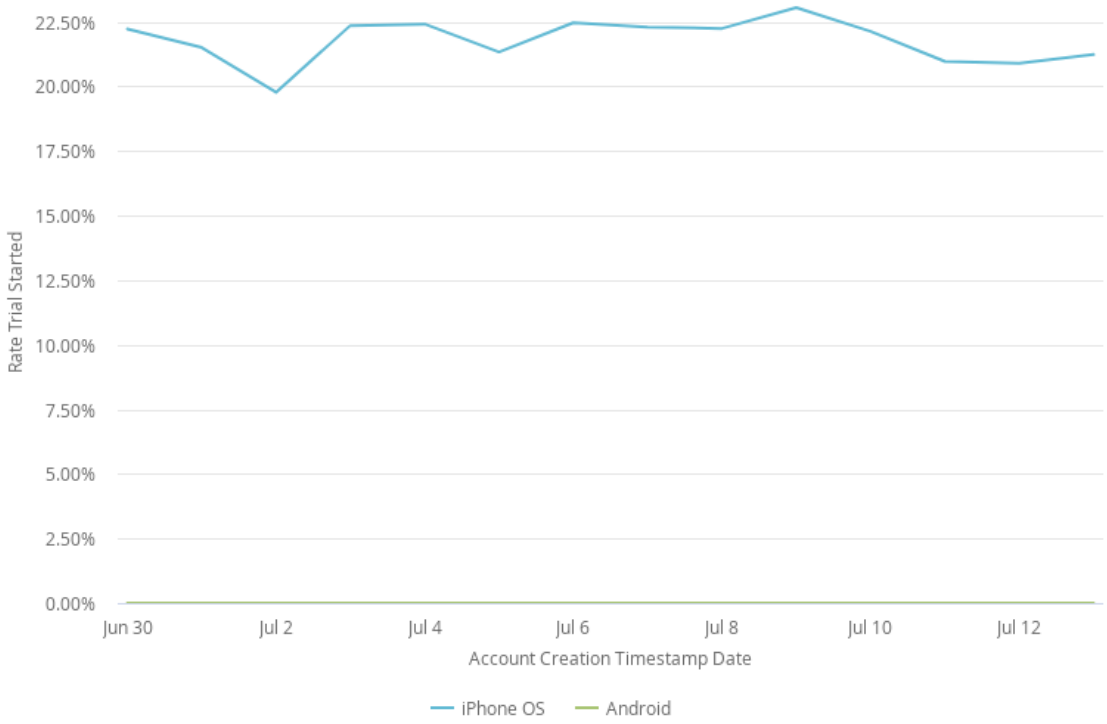


Figure 28: New-to-trial start rates after the introduction of Sign in with Apple only for accounts created with this SSO option

Also with Google Sign In there was no statistically significant improvement in the metrics observed during the experiment, as shown in the next table. If any, retention on day 1 and day 7 had a very small lift.

	Experiment Analysis **Metric**	Experiment Analysis **Variant A**	Experiment Analysis **Variant B**	Experiment Analysis **Num Converted A**	Experiment Analysis **Num Converted B**	Experiment Analysis **Num Total A**	Experiment Analysis **Num Total B**	Experiment Analysis **Revenue A**	Experiment Analysis **Revenue B**	Experiment Analysis **Diff Absolute**	Experiment Analysis **Diff Relative**	Experiment Analysis **Result**	Experiment Analysis **Value A**	Experiment Analysis **Value B**
1	trial_start_to_not_churned_1_day	control_no_google_sso	variant_adds_google_sso	9,012	9,109	10,979	11,109	$0	$0	-0.09%	-0.11%	NO CHANGE	82%	82%
2	subscriber_retention_day_60	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
3	signup_rate	control_no_google_sso	variant_adds_google_sso	60,997	61,155	85,401	85,629	$0	$0	-0.01%	-0.01%	NO CHANGE	71%	71%
4	retention_day_7	control_no_google_sso	variant_adds_google_sso	4,020	4,054	32,008	31,917	$0	$0	0.14%	1.13%	NO CHANGE	13%	13%
5	retention_day_60	control_no_google_sso	variant_adds_google_sso	0	0	26	38	$0	$0	0.0%	∅	NO CHANGE	0%	0%
6	retention_day_30	control_no_google_sso	variant_adds_google_sso	0	0	26	38	$0	$0	0.0%	∅	NO CHANGE	0%	0%
7	retention_day_1	control_no_google_sso	variant_adds_google_sso	16,361	16,615	60,801	60,954	$0	$0	0.35%	1.30%	NO CHANGE	27%	27%
8	first_event_retention_day_7	control_no_google_sso	variant_adds_google_sso	4,170	4,221	32,646	32,581	$0	$0	0.18%	1.42%	NO CHANGE	13%	13%
9	first_event_retention_day_60	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
10	first_event_retention_day_30	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
11	first_event_retention_day_1	control_no_google_sso	variant_adds_google_sso	17,259	17,488	60,997	61,155	$0	$0	0.3%	1.07%	NO CHANGE	28%	29%
12	conversion_unchurned_in_4_weeks_before_annual_renewal	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
13	conversion_trial_started_6_weeks	control_no_google_sso	variant_adds_google_sso	0	0	26	38	$0	$0	0.0%	∅	NO CHANGE	0%	0%
14	conversion_trial_started_1_weeks	control_no_google_sso	variant_adds_google_sso	7,270	7,461	37,405	37,499	$0	$0	0.46%	2.37%	NO CHANGE	19%	20%
15	conversion_trial_started_1_days	control_no_google_sso	variant_adds_google_sso	10,979	11,109	60,977	61,132	$0	$0	0.17%	0.93%	NO CHANGE	18%	18%
16	conversion_trial_start_to_convert_6_weeks	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
17	conversion_trial_start_to_convert_4_weeks_and_not_churned	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
18	conversion_trial_start_to_convert_3_weeks	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
19	conversion_trial_start_to_convert_2_weeks	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
20	conversion_refunded_6_weeks	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
21	conversion_refunded_4_weeks	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
22	conversion_refunded_3_weeks	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
23	conversion_purchase_to_unchurned_6_weeks	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
24	conversion_purchase_to_unchurned_4_weeks	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
25	conversion_purchase_to_unchurned_3_weeks	control_no_google_sso	variant_adds_google_sso	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
26	conversion_nontrial_converted_6_weeks	control_no_google_sso	variant_adds_google_sso	0	0	26	38	$0	$0	0.0%	∅	NO CHANGE	0%	0%
27	conversion_nontrial_converted_3_weeks	control_no_google_sso	variant_adds_google_sso	0	0	27	38	$0	$0	0.0%	∅	NO CHANGE	0%	0%
28	conversion_nontrial_converted_2_weeks	control_no_google_sso	variant_adds_google_sso	0	0	29	39	$0	$0	0.0%	∅	NO CHANGE	0%	0%
29	conversion_any_converted_6_weeks	control_no_google_sso	variant_adds_google_sso	0	0	26	38	$0	$0	0.0%	∅	NO CHANGE	0%	0%

Figure 29: Metrics observed during the experiment introducing Google Sign In

These results show how the introduction of new SSO options and asking for less personal information had only a slightly positive impact on the performance of the

onboarding. This could also simply be a consequence of a sign-up process that was already flexible enough with the Facebook and email options, as we saw from users' comments in the usability studies. In any case, making the registration process smoother may have benefits that are harder to evaluate in this phase of the user experience, related to the feeling of trust the user builds with the product.

4.1.3 Up-sell

The changes on the up-sell screen include new copies for the text of the trial button.

None of the button copy states registered significant changes to any conversion metrics. However, there were significant Day 1 and Day 7 drops in retention on two of the button variants:

- -1.8% to -2.4% for **Start your 7-day free trial**
- -6.4% to -6.7% for **Start my free week**

These retention drops are interesting, since they suggest that certain button copy states can maintain conversion rates constant (through trial starts) but increase or decrease the number of free users that progress past this screen. This gives a great opportunity to increase free engagement without sacrificing subscribers.

	Experiment Analysis **Metric**	Experiment Analysis **Variant A**	Experiment Analysis **Variant B**	Experiment Analysis **Variants Count**	Experiment Analysis **Num Converted A**	Experiment Analysis **Num Converted B**	Experiment Analysis **Num Total A**	Experiment Analysis **Num Total B**	Experiment Analysis **Revenue A**	Experiment Analysis **Revenue B**	Experiment Analysis **Diff Absolute**	Experiment Analysis **Diff Relative**	Experiment Analysis **Result**	Experiment Analysis **Value A**	Experiment Analysis **Value B**
1	trial_start_to_not_churned_1_day	control_try_7_days_for_free	variant_start_your_7_day_free_trial	2	12,328	11,817	15,135	14,471	$0	$0	0.21%	0.25%	NO CHANGE	81%	82%
2	trial_start_to_not_churned_1_day	control_try_7_days_for_free	variant_start_my_free_week	2	12,303	12,556	15,120	15,370	$0	$0	0.32%	0.40%	NO CHANGE	81%	82%
3	trial_start_to_not_churned_1_day	control_try_7_days_for_free	variant_start_7_day_free_trial	2	12,317	12,221	15,130	14,989	$0	$0	0.13%	0.15%	NO CHANGE	81%	82%
4	subscriber_retention_day_60	control_try_7_days_for_free	variant_start_your_7_day_free_trial	2	868	799	6,288	6,023	$0	$0	-0.54%	-3.90%	NO CHANGE	14%	13%
5	subscriber_retention_day_60	control_try_7_days_for_free	variant_start_my_free_week	2	853	886	6,284	6,339	$0	$0	0.4%	2.97%	NO CHANGE	14%	14%
6	subscriber_retention_day_60	control_try_7_days_for_free	variant_start_7_day_free_trial	2	860	919	6,292	6,283	$0	$0	0.96%	7.01%	NO CHANGE	14%	15%
7	signup_rate	control_try_7_days_for_free	variant_start_your_7_day_free_trial	2	131,395	131,331	188,426	188,154	$0	$0	0.07%	0.10%	NO CHANGE	70%	70%
8	signup_rate	control_try_7_days_for_free	variant_start_my_free_week	2	131,442	131,050	188,474	188,162	$0	$0	-0.09%	-0.13%	NO CHANGE	70%	70%
9	signup_rate	control_try_7_days_for_free	variant_start_7_day_free_trial	2	131,468	132,327	188,502	189,520	$0	$0	0.08%	0.11%	NO CHANGE	70%	70%
10	retention_day_7	control_try_7_days_for_free	variant_start_your_7_day_free_trial	2	14,720	14,375	130,243	130,185	$0	$0	-0.26%	-2.30%	DROP	11%	11%
11	retention_day_7	control_try_7_days_for_free	variant_start_my_free_week	2	14,740	13,695	130,307	129,961	$0	$0	-0.77%	-6.84%	DROP	11%	11%
12	retention_day_7	control_try_7_days_for_free	variant_start_7_day_free_trial	2	14,751	14,851	130,324	131,134	$0	$0	0.01%	0.06%	NO CHANGE	11%	11%
13	retention_day_60	control_try_7_days_for_free	variant_start_your_7_day_free_trial	2	3,718	3,634	128,922	128,875	$0	$0	-0.06%	-2.22%	NO CHANGE	3%	3%
14	retention_day_60	control_try_7_days_for_free	variant_start_my_free_week	2	3,722	3,489	128,987	128,612	$0	$0	-0.17%	-5.99%	DROP	3%	3%
15	retention_day_60	control_try_7_days_for_free	variant_start_7_day_free_trial	2	3,726	3,816	129,003	129,786	$0	$0	0.05%	1.80%	NO CHANGE	3%	3%
16	retention_day_30	control_try_7_days_for_free	variant_start_your_7_day_free_trial	2	5,996	5,908	129,965	129,883	$0	$0	-0.06%	-1.41%	NO CHANGE	5%	5%
17	retention_day_30	control_try_7_days_for_free	variant_start_my_free_week	2	6,006	5,604	130,029	129,658	$0	$0	-0.3%	-6.43%	DROP	5%	4%
18	retention_day_30	control_try_7_days_for_free	variant_start_7_day_free_trial	2	6,005	6,115	130,046	130,847	$0	$0	0.06%	1.21%	NO CHANGE	5%	5%
19	retention_day_1	control_try_7_days_for_free	variant_start_your_7_day_free_trial	2	32,694	32,075	130,298	130,249	$0	$0	-0.47%	-1.86%	DROP	25%	25%
20	retention_day_1	control_try_7_days_for_free	variant_start_my_free_week	2	32,723	30,492	130,362	130,007	$0	$0	-1.65%	-6.56%	DROP	25%	23%
21	retention_day_1	control_try_7_days_for_free	variant_start_7_day_free_trial	2	32,725	32,676	130,379	131,196	$0	$0	-0.19%	-0.77%	NO CHANGE	25%	25%
22	first_event_retention_day_7	control_try_7_days_for_free	variant_start_your_7_day_free_trial	2	14,933	14,559	130,315	130,261	$0	$0	-0.28%	-2.46%	DROP	11%	11%
23	first_event_retention_day_7	control_try_7_days_for_free	variant_start_my_free_week	2	14,959	13,855	130,379	130,012	$0	$0	-0.82%	-7.12%	DROP	11%	11%
24	first_event_retention_day_7	control_try_7_days_for_free	variant_start_7_day_free_trial	2	14,971	15,033	130,396	131,215	$0	$0	-0.02%	-0.21%	NO CHANGE	11%	11%
25	first_event_retention_day_60	control_try_7_days_for_free	variant_start_your_7_day_free_trial	2	3,787	3,723	130,315	130,261	$0	$0	-0.05%	-1.65%	NO CHANGE	3%	3%
26	first_event_retention_day_60	control_try_7_days_for_free	variant_start_my_free_week	2	3,793	3,553	130,379	130,012	$0	$0	-0.18%	-6.06%	DROP	3%	3%
27	first_event_retention_day_60	control_try_7_days_for_free	variant_start_7_day_free_trial	2	3,795	3,890	130,396	131,215	$0	$0	0.05%	1.86%	NO CHANGE	3%	3%
28	first_event_retention_day_30	control_try_7_days_for_free	variant_start_your_7_day_free_trial	2	6,045	5,966	130,315	130,261	$0	$0	-0.06%	-1.27%	NO CHANGE	5%	5%
29	first_event_retention_day_30	control_try_7_days_for_free	variant_start_my_free_week	2	6,056	5,678	130,379	130,012	$0	$0	-0.28%	-5.98%	DROP	5%	4%
30	first_event_retention_day_30	control_try_7_days_for_free	variant_start_7_day_free_trial	2	6,055	6,195	130,396	131,215	$0	$0	0.08%	1.67%	NO CHANGE	5%	5%
31	first_event_retention_day_1	control_try_7_days_for_free	variant_start_your_7_day_free_trial	2	34,487	33,909	130,315	130,261	$0	$0	-0.43%	-1.64%	DROP	26%	26%

Figure 30: Metrics observed during the experiment changing the button copy on the up-sell screen

4.1.4 First training session

The changes in the first training session include the introduction of the streak widget on the training screen and some changes to the gameplay.

The introduction of the streak widget on the training screen did not move any of the observed metric. It seems likely - based on these number combined with what users said about streaks in UX research - that those who use streaks to motivate themselves are all already finding streak info "available enough" within the control

experience. Those who do not motivate themselves with streaks may simply not be "convertible" enough, on average, to the other group.

	Experiment Analysis Metric	Experiment Analysis Variant A	Experiment Analysis Variant B	Experiment Analysis Variants Count	Experiment Analysis Num Converted A	Experiment Analysis Num Converted B	Experiment Analysis Num Total A	Experiment Analysis Num Total B	Experiment Analysis Revenue A	Experiment Analysis Revenue B	Experiment Analysis Diff Absolute	Experiment Analysis Diff Relative	Experiment Analysis Result	Experiment Analysis Value A	Experiment Analysis Value B
1	trial_start_to_not_churned_1_day	no	yes	2	22,387	22,297	28,240	28,067	$0	$0	0.17%	0.21%	NO CHANGE	79%	79%
2	subscriber_retention_day_60	no	yes	2	1,307	1,353	12,026	11,873	$0	$0	0.53%	4.85%	NO CHANGE	11%	11%
3	signup_rate	no	yes	2	147,685	146,685	147,685	146,685	$0	$0	0.0%	0.00%	NO CHANGE	100%	100%
4	retention_day_7	no	yes	2	19,139	18,992	145,936	144,927	$0	$0	-0.01%	-0.08%	NO CHANGE	13%	13%
5	retention_day_60	no	yes	2	4,675	4,678	145,936	144,927	$0	$0	0.02%	0.76%	NO CHANGE	3%	3%
6	retention_day_30	no	yes	2	7,484	7,499	145,936	144,927	$0	$0	0.05%	0.90%	NO CHANGE	5%	5%
7	retention_day_1	no	yes	2	41,125	40,787	145,936	144,927	$0	$0	-0.04%	-0.13%	NO CHANGE	28%	28%
8	first_event_retention_day_7	no	yes	2	19,337	19,179	145,936	144,927	$0	$0	-0.02%	-0.13%	NO CHANGE	13%	13%
9	first_event_retention_day_60	no	yes	2	4,675	4,695	145,936	144,927	$0	$0	0.04%	1.13%	NO CHANGE	3%	3%
10	first_event_retention_day_30	no	yes	2	7,510	7,516	145,936	144,927	$0	$0	0.04%	0.78%	NO CHANGE	5%	5%
11	first_event_retention_day_1	no	yes	2	43,050	42,764	145,936	144,927	$0	$0	0.01%	0.03%	NO CHANGE	29%	30%
12	conversion_unchurned_in_4_weeks_before_annual_renewal	no	yes	2	5	0	5	0	$0	$0	∅	∅	NO CHANGE	100%	∅
13	conversion_trial_started_6_weeks	no	yes	2	30,471	30,145	147,685	146,685	$0	$0	-0.08%	-0.40%	NO CHANGE	21%	21%
14	conversion_trial_started_1_weeks	no	yes	2	29,978	29,671	147,685	146,685	$0	$0	-0.07%	-0.35%	NO CHANGE	20%	20%
15	conversion_trial_start_to_convert_6_weeks	no	yes	2	11,779	11,585	30,471	30,145	$0	$0	-0.23%	-0.58%	NO CHANGE	39%	38%
16	conversion_trial_start_to_convert_4_weeks_and_not_churned	no	yes	2	8,466	8,348	30,398	30,077	$0	$0	-0.1%	-0.34%	NO CHANGE	28%	28%
17	conversion_trial_start_to_convert_3_weeks	no	yes	2	11,521	11,351	30,349	30,027	$0	$0	-0.16%	-0.42%	NO CHANGE	38%	38%
18	conversion_trial_start_to_convert_2_weeks	no	yes	2	11,384	11,206	30,238	29,935	$0	$0	-0.21%	-0.57%	NO CHANGE	38%	37%
19	conversion_refunded_6_weeks	no	yes	2	889	825	13,003	12,808	$0	$0	-0.4%	-5.79%	NO CHANGE	7%	6%
20	conversion_refunded_4_weeks	no	yes	2	816	767	12,842	12,640	$0	$0	-0.29%	-4.50%	NO CHANGE	6%	6%
21	conversion_refunded_3_weeks	no	yes	2	736	690	12,693	12,523	$0	$0	-0.29%	-4.98%	NO CHANGE	6%	6%
22	conversion_purchase_to_unchurned_6_weeks	no	yes	2	8,907	8,757	31,066	30,723	$0	$0	-0.17%	-0.59%	NO CHANGE	29%	29%
23	conversion_purchase_to_unchurned_4_weeks	no	yes	2	9,266	9,156	30,993	30,654	$0	$0	-0.03%	-0.09%	NO CHANGE	30%	30%
24	conversion_purchase_to_unchurned_3_weeks	no	yes	2	9,518	9,434	30,944	30,603	$0	$0	0.07%	0.22%	NO CHANGE	31%	31%
25	conversion_nontrial_converted_6_weeks	no	yes	2	1,490	1,464	147,685	146,685	$0	$0	-0.01%	-1.08%	NO CHANGE	1%	1%
26	conversion_nontrial_converted_3_weeks	no	yes	2	1,314	1,303	147,685	146,685	$0	$0	0.0%	-0.16%	NO CHANGE	1%	1%
27	conversion_nontrial_converted_2_weeks	no	yes	2	1,231	1,217	147,685	146,685	$0	$0	0.0%	-0.46%	NO CHANGE	1%	1%

Figure 31: Metrics observed during the experiment introducing a training streak widget in the training tab

No statistically significant difference can be observed with the experiment changing the post-game high score messaging to emphasize the fact that the score refers to the user's personal best instead of a comparison with other users. This could either mean that users do not really give a great importance to this message, or that the new copy was not different enough from the old one to make the concept clear for everyone.

Experiment Analysis Metric	Experiment Analysis Variant A	Experiment Analysis Variant B	Experiment Analysis Variants Count	Experiment Analysis Num Converted A	Experiment Analysis Num Converted B	Experiment Analysis Num Total A	Experiment Analysis Num Total B	Experiment Analysis Revenue A	Experiment Analysis Revenue B	Experiment Analysis Diff Absolute	Experiment Analysis Diff Relative	Experiment Analysis Result	Experiment Analysis Value A	Experiment Analysis Value B
trial_start_to_not_churned_1_day	control_high_score	variant_your_new_high_score	2	11,452	11,459	14,119	14,146	$0	$0	-0.11%	-0.13%	NO CHANGE	81%	81%
subscriber_retention_day_60	control_high_score	variant_your_new_high_score	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
signup_rate	control_high_score	variant_your_new_high_score	2	97,548	96,724	97,550	96,726	$0	$0	0.0%	-0.00%	NO CHANGE	100%	100%
retention_day_7	control_high_score	variant_your_new_high_score	2	11,799	11,754	97,548	96,724	$0	$0	0.06%	0.47%	NO CHANGE	12%	12%
retention_day_60	control_high_score	variant_your_new_high_score	2	1	0	169	14	$0	$0	-0.59%	-100.00%	NO CHANGE	1%	0%
retention_day_30	control_high_score	variant_your_new_high_score	2	0	0	177	14	$0	$0	0.0%	∅	NO CHANGE	0%	0%
retention_day_1	control_high_score	variant_your_new_high_score	2	26,200	26,218	97,548	96,724	$0	$0	0.25%	0.92%	NO CHANGE	27%	27%
first_event_retention_day_7	control_high_score	variant_your_new_high_score	2	11,871	11,869	97,548	96,724	$0	$0	0.1%	0.83%	NO CHANGE	12%	12%
first_event_retention_day_60	control_high_score	variant_your_new_high_score	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
first_event_retention_day_30	control_high_score	variant_your_new_high_score	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
first_event_retention_day_1	control_high_score	variant_your_new_high_score	2	27,556	27,494	97,548	96,724	$0	$0	0.18%	0.62%	NO CHANGE	28%	28%
conversion_unchurned_in_4_weeks_before_annual_renewal	control_high_score	variant_your_new_high_score	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
conversion_trial_started_6_weeks	control_high_score	variant_your_new_high_score	2	0	0	173	14	$0	$0	0.0%	∅	NO CHANGE	0%	0%
conversion_trial_started_1_weeks	control_high_score	variant_your_new_high_score	2	14,949	15,002	97,548	96,724	$0	$0	0.19%	1.21%	NO CHANGE	15%	16%
conversion_trial_started_1_days	control_high_score	variant_your_new_high_score	2	14,119	14,146	97,548	96,724	$0	$0	0.15%	1.04%	NO CHANGE	14%	15%
conversion_trial_start_to_convert_6_weeks	control_high_score	variant_your_new_high_score	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
conversion_trial_start_to_convert_4_weeks_and_not_churned	control_high_score	variant_your_new_high_score	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
conversion_trial_start_to_convert_3_weeks	control_high_score	variant_your_new_high_score	2	3,253	3,352	8,309	8,392	$0	$0	0.79%	2.02%	NO CHANGE	39%	40%
conversion_trial_start_to_convert_2_weeks	control_high_score	variant_your_new_high_score	2	5,862	5,937	15,058	15,118	$0	$0	0.34%	0.88%	NO CHANGE	39%	39%
conversion_refunded_6_weeks	control_high_score	variant_your_new_high_score	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
conversion_refunded_4_weeks	control_high_score	variant_your_new_high_score	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
conversion_refunded_3_weeks	control_high_score	variant_your_new_high_score	2	176	197	3,464	3,523	$0	$0	0.51%	10.06%	NO CHANGE	5%	6%
conversion_purchase_to_unchurned_6_weeks	control_high_score	variant_your_new_high_score	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
conversion_purchase_to_unchurned_4_weeks	control_high_score	variant_your_new_high_score	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
conversion_purchase_to_unchurned_3_weeks	control_high_score	variant_your_new_high_score	2	2,688	2,741	8,387	8,433	$0	$0	0.45%	1.42%	NO CHANGE	32%	33%
conversion_nontrial_converted_6_weeks	control_high_score	variant_your_new_high_score	2	0	0	173	14	$0	$0	0.0%	∅	NO CHANGE	0%	0%
conversion_nontrial_converted_3_weeks	control_high_score	variant_your_new_high_score	2	253	215	54,114	53,503	$0	$0	-0.07%	-14.05%	NO CHANGE	0%	0%

Figure 32: Metrics observed during the experiment changing the high score messaging

The experiment introducing easier first day fail rates proved to increase significantly retention metrics on day 1 and day 7, meaning that users feel more confident to come back to the app if they fail rarely in their first games. Among the two variants reducing the fail rate by 50% and 90%, the first also generated a lift in the number of users who do not cancel their subscription on day one after starting a

trial. This could mean that this option created the best compromise between games being challenging and easy enough, so that the user is not only pushed to come back, but also to keep paying after the trial.

	Experiment Analysis **Metric**	Experiment Analysis **Variant B**	Experiment Analysis **Variants Count**	Experiment Analysis **Num Converted A**	Experiment Analysis **Num Converted B**	Experiment Analysis **Num Total A**	Experiment Analysis **Num Total B**	Experiment Analysis **Revenue A**	Experiment Analysis **Revenue B**	Experiment Analysis **Diff Absolute**	Experiment Analysis **Diff Relative**	Experiment Analysis **Result**	Experiment Analysis **Value A**	Experiment Analysis **Value B**
36	trial_start_to_not_churned_1_day	variant_reduce_fail_rate_by_50_percent	2	7,521	7,673	9,300	9,268	$0	$0	1.92%	2.37%	LIFT	81%	83%
37	subscriber_retention_day_60	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
38	signup_rate	variant_reduce_fail_rate_by_50_percent	2	59,309	59,167	59,309	59,168	$0	$0	0.0%	-0.00%	NO CHANGE	100%	100%
39	retention_day_7	variant_reduce_fail_rate_by_50_percent	2	3,658	3,828	31,932	31,618	$0	$0	0.65%	5.69%	LIFT	11%	12%
40	retention_day_60	variant_reduce_fail_rate_by_50_percent	2	0	0	217	6	$0	$0	0.0%	∅	NO CHANGE	0%	0%
41	retention_day_30	variant_reduce_fail_rate_by_50_percent	2	0	0	223	6	$0	$0	0.0%	∅	NO CHANGE	0%	0%
42	retention_day_1	variant_reduce_fail_rate_by_50_percent	2	15,213	15,721	59,309	59,167	$0	$0	0.92%	3.59%	LIFT	26%	27%
43	first_event_retention_day_7	variant_reduce_fail_rate_by_50_percent	2	3,804	3,954	32,467	32,209	$0	$0	0.56%	4.78%	LIFT	12%	12%
44	first_event_retention_day_60	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
45	first_event_retention_day_30	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
46	first_event_retention_day_1	variant_reduce_fail_rate_by_50_percent	2	16,082	16,509	59,309	59,167	$0	$0	0.79%	2.90%	LIFT	27%	28%
47	conversion_unchurned_in_4_weeks_before_annual_renewal	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
48	conversion_trial_started_6_weeks	variant_reduce_fail_rate_by_50_percent	2	0	0	217	6	$0	$0	0.0%	∅	NO CHANGE	0%	0%
49	conversion_trial_started_1_weeks	variant_reduce_fail_rate_by_50_percent	2	6,291	6,318	37,063	36,751	$0	$0	0.22%	1.28%	NO CHANGE	17%	17%
50	conversion_trial_started_1_days	variant_reduce_fail_rate_by_50_percent	2	9,300	9,268	59,309	59,167	$0	$0	-0.02%	-0.10%	NO CHANGE	16%	16%
51	conversion_trial_start_to_convert_6_weeks	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
52	conversion_trial_start_to_convert_4_weeks_and_not_churned	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
53	conversion_trial_start_to_convert_3_weeks	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
54	conversion_trial_start_to_convert_2_weeks	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
55	conversion_refunded_6_weeks	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
56	conversion_refunded_4_weeks	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
57	conversion_refunded_3_weeks	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
58	conversion_purchase_to_unchurned_6_weeks	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
59	conversion_purchase_to_unchurned_4_weeks	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
60	conversion_purchase_to_unchurned_3_weeks	variant_reduce_fail_rate_by_50_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
61	conversion_nontrial_converted_6_weeks	variant_reduce_fail_rate_by_50_percent	2	0	0	217	6	$0	$0	0.0%	∅	NO CHANGE	0%	0%
62	conversion_nontrial_converted_3_weeks	variant_reduce_fail_rate_by_50_percent	2	0	0	235	6	$0	$0	0.0%	∅	NO CHANGE	0%	0%

Figure 33: Metrics observed during the experiment reducing the fail rate on day one by 50%

	Experiment Analysis **Metric**	Experiment Analysis **Variant B**	Experiment Analysis **Variants Count**	Experiment Analysis **Num Converted A**	Experiment Analysis **Num Converted B**	Experiment Analysis **Num Total A**	Experiment Analysis **Num Total B**	Experiment Analysis **Revenue A**	Experiment Analysis **Revenue B**	Experiment Analysis **Diff Absolute**	Experiment Analysis **Diff Relative**	Experiment Analysis **Result**	Experiment Analysis **Value A**	Experiment Analysis **Value B**
1	trial_start_to_not_churned_1_day	variant_reduce_fail_rate_by_90_percent	2	7,524	7,507	9,304	9,176	$0	$0	0.94%	1.17%	NO CHANGE	81%	82%
2	subscriber_retention_day_60	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
3	signup_rate	variant_reduce_fail_rate_by_90_percent	2	59,315	59,033	59,315	59,033	$0	$0	0.0%	0.00%	NO CHANGE	100%	100%
4	retention_day_7	variant_reduce_fail_rate_by_90_percent	2	3,657	3,854	31,929	31,775	$0	$0	0.68%	5.90%	LIFT	11%	12%
5	retention_day_60	variant_reduce_fail_rate_by_90_percent	2	0	0	218	5	$0	$0	0.0%	∅	NO CHANGE	0%	0%
6	retention_day_30	variant_reduce_fail_rate_by_90_percent	2	0	0	224	5	$0	$0	0.0%	∅	NO CHANGE	0%	0%
7	retention_day_1	variant_reduce_fail_rate_by_90_percent	2	15,214	15,551	59,315	59,033	$0	$0	0.69%	2.70%	LIFT	26%	26%
8	first_event_retention_day_7	variant_reduce_fail_rate_by_90_percent	2	3,803	3,993	32,460	32,366	$0	$0	0.62%	5.30%	LIFT	12%	12%
9	first_event_retention_day_60	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
10	first_event_retention_day_30	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
11	first_event_retention_day_1	variant_reduce_fail_rate_by_90_percent	2	16,085	16,370	59,315	59,033	$0	$0	0.61%	2.26%	LIFT	27%	28%
12	conversion_unchurned_in_4_weeks_before_annual_renewal	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
13	conversion_trial_started_6_weeks	variant_reduce_fail_rate_by_90_percent	2	0	0	218	5	$0	$0	0.0%	∅	NO CHANGE	0%	0%
14	conversion_trial_started_1_weeks	variant_reduce_fail_rate_by_90_percent	2	6,290	6,227	37,059	36,895	$0	$0	-0.1%	-0.56%	NO CHANGE	17%	17%
15	conversion_trial_started_1_days	variant_reduce_fail_rate_by_90_percent	2	9,304	9,176	59,315	59,033	$0	$0	-0.14%	-0.90%	NO CHANGE	16%	16%
16	conversion_trial_start_to_convert_6_weeks	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
17	conversion_trial_start_to_convert_4_weeks_and_not_churned	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
18	conversion_trial_start_to_convert_3_weeks	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
19	conversion_trial_start_to_convert_2_weeks	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
20	conversion_refunded_6_weeks	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
21	conversion_refunded_4_weeks	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
22	conversion_refunded_3_weeks	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
23	conversion_purchase_to_unchurned_6_weeks	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
24	conversion_purchase_to_unchurned_4_weeks	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
25	conversion_purchase_to_unchurned_3_weeks	variant_reduce_fail_rate_by_90_percent	2	0	0	0	0	$0	$0	∅	∅	NO CHANGE	∅	∅
26	conversion_nontrial_converted_6_weeks	variant_reduce_fail_rate_by_90_percent	2	0	0	218	5	$0	$0	0.0%	∅	NO CHANGE	0%	0%
27	conversion_nontrial_converted_3_weeks	variant_reduce_fail_rate_by_90_percent	2	0	0	236	5	$0	$0	0.0%	∅	NO CHANGE	0%	0%

Figure 34: Metrics observed during the experiment reducing the fail rate on day one by 90%

4.1.5 Re-onboarding

The only change implemented for the re-onboarding of churned users is the win-back offers introduced at the end of a trial or subscription, with different messages depending on when the previous subscription was terminated.

The following graph shows the number of purchases completed grouped by experiment variant, and proves that users in the treatment group were way more likely to purchase than users in the control group or not exposed to the experiment.

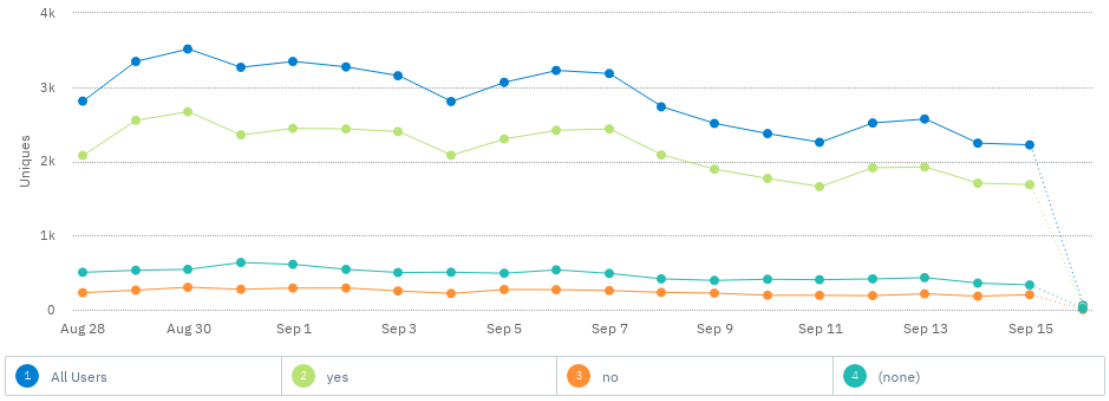


Figure 35: Purchases completed grouped by experiment variant in the win-back offers experiment

5 Discussion

This section focuses on the generalization of the results following this thesis work to the broader mobile applications industry and research community.

Since this work has been performed in a particular context, i.e., of brain training apps, some findings well generalize to other contexts, while some others do not and pose limitations and challenges for future developments in onboarding experiences for novice users.

5.1 Guidelines for industry and research community

Results from the developments on the Elevate app and the usability studies with new and existing users led to answering the research questions presented in the Introduction section, thus providing guidelines for the industry and the research community.

RQ1: Which factors determine the best user onboarding flow for a mobile app? User onboarding needs to make the user aware of what value the mobile app can offer, of how he can achieve that value, and of why what this value can bring to his daily life. Interest needs to be increased until the user decides to create an account, pay for the service, and return to the product in the future. In order to achieve these results, onboarding has to be:

- Fast, simple, and effortless
- Concise and direct
- Instructive and helpful
- Appealing, both from a functional and aesthetic point of view
- Value-focused

The order with which onboarding elements are proposed proved to be crucial in the experiment with the trial pitch card in Elevate. Simply mentioning too early that a free trial is all the user can get for free caused a big drop-off, before really appreciating what Elevate has to offer. Actions that correspond to a great commitment, such as the creation of an account or the activation of a trial or paid feature, should be postponed to a later moment when the user's interest in the value of the product reaches a peak.

RQ2: How does onboarding relate to life changes in a user? When is re-onboarding required at various stages? Mobile apps are so easy to get and replace that users are likely to subscribe and unsubscribe to products at a faster pace than what they would do with other types of products. Loyal users interviewed for this project proved to often have some bigger life goal giving them motivation to shay sharp and focused with a product like Elevate.

For this reason, life changes may push the user to keep the product only at a discounted price, or come back later when his motivation towards the proposed value is higher again.

TODO talk about the results of the win-back campaign

RQ3: How can onboarding be used to let users gain more trust and confidence in the apps, with greater transparency of what data the app collects and how it can be used? Privacy is becoming a more and more pressing concern in the world of mobile apps, and users are constantly advocating for less tracking of their sensitive data in mobile apps.

At the same time, they are sometimes so used to give away their data to digital services that sometimes this feels just owed to the developer.

The addition of SSO options and the removal of the collection of first and last name in Elevate provided not so clear results, since changes to metrics were only slightly positive. However, opinions from interviews and the unmoderated usability study prove that there may be benefits that are harder to evaluate in the early stages of the user experiences, related to the feeling of trust the user builds with the product.

RQ4: How can incremental onboarding allow users a light touch of the platform before using it and becoming useful enough for a premium account? New users can easily start using a mobile app with a totally different idea of what the product really is. In this project, this was proved both by the high drop-off rates observed in many parts of the onboarding flow, and by the opinions of users in the unmoderated study, which usually changed their mind in a very positive way about the benefits offered by Elevate only after going through the entire flow.

In particular, the selection of training goals and the evaluation of a training test before using the actual product proved to be two very effective means of creating trust in what Elevate wants his users to achieve.

Moreover, clarifying scores and gameplay rules in the first-day experience is something that many users asked for and that proved TODO

RQ5: What are the positive and negative aspects of the onboarding flow in the most popular brain training mobile apps? No distinct pattern could be identified in terms of onboarding for brain training mobile apps.

Some, like Elevate, offer a long onboarding flow that tries to emphasize the value of the product and the personalization of a training program, to then ask for account creation and activation of a free trial or paid version.

Others try to get users quickly to the training games, and postpone to a later point friction elements such as the account creation and discovery of a pro version.

Another distinctive element is the way personalization and instructions are handled. Some apps use tutorials and example exercises to guide the user towards getting comfortable with the game mechanics, while others skip these elements of help to make the process faster.

Observation of the success achieved by these different apps and studies performed on Elevate tend to promote long onboarding flows with an emphasis on proposed value, personalization, and learnability.

RQ6: How to design and implement an optimal onboarding landing screen for a brain training app? Elevate users seemed to be very satisfied by the welcome screen and pitch cards explaining the basics of the app. The experiment on the flow of these initial screens showed no big difference in providing ways to skip this introductory pages for returning users. On the other side, it was clear that elements related to a commitment to the product, such as mentioning a trial, should be delayed to a later point when trust is stronger. Landing screens and welcome tour should then only present in a summarized way the benefits of the product in a light way.

RQ7: How to design and implement an optimal registration flow for a brain training app? How to leverage new Single Sign-On (SSO) solutions in this flow? Account registration should come in a stage of onboarding where the user has built enough trust with the product and the value it provides, so that he can easily agree on sharing personal data.

SSO options can facilitate the process and make it faster. Users use and say they like them, even though it does not seem that adding many of them makes a big difference compared to have a subset of them. In this project Apple's and Google's SSO systems were added to Facebook's one, but metrics improved only slightly. This is probably a consequence of users not making much difference among the SSO providers, so as long as there is one of these common options available users will be satisfied.

TO DO talk about Google SignIn

RQ8: How to create the best flow to define training goals and assess a user's current skill level? Elevate asks questions on training goals and tests the cognitive skills of the user early in the onboarding process. Users seem to appreciate a lot these two activities, and for this reason no action was taken in the context of this project on them. This is in line with what many other brain training apps do to create personalization before start using the training programs.

RQ9: How to connect the onboarding experience to the initial training sessions and to the start of a free trial? Having a good onboarding flow can be not enough when users struggle in their first attempts at the games composing the training sessions. For this reason, game mechanics have to be developed with clarity and attention, providing explanations about rules and scoring systems, and about how these elements connect to the training program. Instructing players to make use of the app effectively is in general an important requisite for all types of apps to create retention and make trials and premium features look more appealing and worth their cost.

Free trials and paid features represent a big commitment for a user, especially when the app is initially presented to be available for free. The timing and messaging used to propose an up-sell is crucial to avoid scaring users and make them drop before they are really able to assess the value they can get from the product.

RQ10: What improvements can this work generate in terms of user acquisition, retention, and churn? The analysis of onboarding flows in this project and the use case with the Elevate app proves that a careful design of onboarding can significantly contribute to bring and keep more customers on-board in mobile apps.

User acquisition can increase as a result of well-designed welcome screens and registration options.

User retention can increase as a result of well-designed first-day experience with the main features of the app. In the case of a brain training app, this translates to an appealing, motivating, and effortless first training session.

User churn can decrease as a result of the win-back mechanism trying to bring the customer back to the product with well-timed messages and promotional prices.

5.2 Limitations of this work

This work analyzes the onboarding flow of a brain training app. This means that some elements of the flow are not common in other types of apps, especially in non-games apps.

The considerations made on welcome screens, account registration, and selling a paid version can easily be generalized to most of the apps available on mobile devices.

The following comparisons can be made between some stages of Elevate's on-boarding that are particular to its app category and other apps:

- The questions on training goals represent what in many apps is a way of customizing the user experience to the objectives of a new user. For example, the analysis of other apps with a successful onboarding showed that they use a similar technique to set:
  - Workout goals
  - House search parameters
  - Favorite book genres
  - Most used beauty products
- The training test is another way of creating personalization, but in a way that is less controlled by user choices, and more related to his proved capabilities. This personalization element can be present in every app that needs to set a baseline of difficulty for its usage, something that tends to be there in games.
- The training session can be compared to any recurrent activity an app would like the user to perform regularly. Many types of apps rely on the user coming

back on a regular basis to execute tasks or interact with other users, e.g., social networks, entertainment services, and shopping apps. This is why the reflections on emphasizing the learnability and easiness of use of the product in the first interactions well generalize to other apps.

5.3 Research directions for future developments

This project analyzed the onboarding of customers in a brain training mobile app, starting from an already successful product with a structured onboarding process, and applying changes to this process in order to increase goals related to user acquisition, retention, and churn.

Future developments could use the same methodologies for the analysis and improvement of existing onboarding flows in the context of different types of apps. Since brain training apps include a game element, it would be especially interesting to make a similar analysis outside of a gaming context.

Elevate uses a freemium business model with a single in-app purchase. Apps with a different business model could also be another source of new insights, ranging from free apps with in-app advertisement, to paid apps, to sharing economy.

The heavy use of data to empower AI in recent years could also facilitate the automated analysis of the onboarding experience with the help of machine learning. For apps like Elevate, which are used by millions of people, machine learning techniques could enable faster iterations in A/B tests for small UI variations in the onboarding screens. On a company level, it could also help setting up success metrics related to onboarding to inform product strategy, like in [4].

Outside of the mobile context, onboarding is still a crucial activity for every software product. New research could focus on desktop, but also on recent trends like IoT. The introduction of 5G will likely connect many more small objects together in the near future [87], and this will require new studies to understand how to onboard users with these new types of interaction.

6 Conclusion

This thesis analyzed the concept of user onboarding in mobile applications, and tried to define guidelines for the design of an onboarding flow in the context of Elevate, a brain training mobile app.

After analyzing elements and theories related to user onboarding, a state of the art analysis was used to explore the onboarding features of successful applications, with a focus on brain training applications. This background research proved how successful onboarding systems combine fast and direct access to the application with appealing and instructive elements driving the user's interest in what the product offers and ability to get the most out of it.

Consequently, the current onboarding of the Elevate app has been analyzed and discussed in usability studies with new and existing users of the app. The results of this qualitative analysis, the quantitative analysis of the Elevate data pipeline, and the definition of success metrics for onboarding led to the design of requirements for changes to the onboarding stages of Elevate.

The performances of these changes to the Elevate app have been analyzed with A/B tests in order to determine their effectiveness.

Finally, the insights generated by usability studies were combined with the results of the experiments to generate a set of guidelines for the industry and the research community. Additionally, limitations of this work and suggestions for future developments have been provided to help researchers explore more deeply this field in following studies.

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A App usage interview questions

A.1 Invitation email

Subject: Thoughts about Elevate? $20 **gift card!**

Hi <NAME>,

We'd like to hear what role Elevate plays in your life and what you get out of using our app. If you're chosen to share your experience with us, we'll send you a $20 Amazon gift card!

Please fill out this survey to participate: LINK.

If you are selected, we will email you in the upcoming weeks with next steps.

Thank you! The Elevate Team

A.2 Interview questions

The following set of questions has been used in the semi-structured interviews with loyal users, which were used to gain insights on the mental models, values, and contexts around the use of Elevate for long-term users.

- **Introduction**
  - Hi! Thanks for joining me today. I'll start recording now, if that's OK?
  - Just to review, we'd like to talk to you about Elevate and how you use it. I'll be asking most of the questions, and may get some questions from some of my colleagues who are observing as well. A bit later today, we'll send the Amazon gift card to your email address unless you want us to use a different one. Do you have any questions before we get started?
  - Great. I want to start by acknowledging that it's a crazy time for all of us, and I hope you're doing relatively well. As a first question, can you tell me about where you live and your living situation (whether you live with anyone, for example)?
  - And if you're comfortable with it, would you mind describing your employment or career for me?
  - Finally, can you tell me one or two other apps you use most often, excluding messaging apps or social media?
- **Background**
  - Do you remember how you first learned about apps like Elevate?
  - At that time, do you remember what appealed to you about the apps?
  - And do you remember how you first learned about Elevate itself?
  - What made you decide to pay for an Elevate subscription?
- **Context of use**

  - When do you use Elevate? [If not tied to a specific routine] What makes you decide to open the app?
  - Do you associate any particular feeling with opening the app for the first time on a given day?
  - Do you talk to anybody about Elevate? [If they occasionally mention it:] How do you describe Elevate to them? [If they routinely update somebody:] What kinds of things happen in Elevate that you tell them about?

- **Usage and current value**
  - What do you do in the app?
  - Alright, let's dive in to a few of those things. When you open the app to play a game, do you go always through your daily recommended training? Or when (if ever) do you just pick a game you want to play, or play a random game?
  - Do you have a favorite game? What appeals to you about [game]? Any other favorites?
  - Can we talk more about per-game difficulty ratings, each one a number with a maximum of 400? If these went away, would you miss them? Why?
  - What do you like about [identified feature]? When do you typically decide to [use identified feature]? [Followup questions as warranted]
  - What three words or short phrases would you use to describe what using Elevate does for you?

- **Potential value**
  - Is there anything you wish were different about playing games in Elevate or [other features]?
  - Is there anything you wish the app did that it does not do today?
  - Other than using Elevate, what do you do [to get the same kind of value described before]? This could be other apps or things you do away from your phone.

- **Wrap-up**
  - This has been incredibly helpful. Anything else you'd like to share with me today?
  - When we hang up, would you tap the "Share" icon at the top-left of your Performance tab and send that EPQ report to me via email?
  - Thanks so much!

A.3 User quotes

Most participants had profound connections to our product as part of healing or recovery processes or in connection with important social bonds.

- Bob uses Elevate to support and accelerate his recovery from aphasia. “For me, it was a no-brainer that I needed all the stimulation I could get.”
- Brian being able to connect with his school-aged daughter over the challenges of education: “‘Hey, I’m in the same boat..’”
- Melissa shares words she’s learned from the app with her like-minded family, and recommends the app to fellow survivors of her particular kind of cancer (as part of recovery from the cognitive effects of chemotherapy).
- Kevin recommends it to his clients and social media followers and posts gameplay videos on his Instagram.

The words and short phrases participants used to describe the app fell into the categories of improvement, motivation, and enjoyment; affinities were very clean except where outliers are noted as such:

- Improvement: The app improves (or supports improvements of) performance and to a lesser extent knowledge in the domains it covers
  - “Constructive”
  - “Strengtheners” (with a focus on progressing through levels of performance)
  - “Improves”
  - “Improve my job”
  - “Do my job”
  - “Do life”
  - “Clarity” (clear understanding of why language works the way it does, e.g.)
  - “Opens up possibility into my own brain” (slight outlier in the category; was about expanding “thinking” and “capacity”)
- Motivation: The app motivates learning behaviors that might otherwise not be performed
  - “Motivational routine enhancements”
  - “Positive reinforcement”
  - “Portion control[led]”
- Enjoyment: The app provides a pleasing experience, in the context of being a learning / self-improvement tool

  - "Interesting"
  - "Engages"
  - "Challenges" (was about the fun of learning new, hard things)
  - "Focus" (slight outlier about the pleasure of being able to let time with the app be a time of total focus)

The daily session is the core value-delivery mechanism and is synonymous with using Elevate as a concept.

- All participants play the daily session when they use the app. In response to the question, "When do you use Elevate?", all participants described their habits around the daily session.

Freeplayed games (and to a lesser extent study guides) are value-adds.

- Some participants freeplay specific games where they have deficiencies; others freeplay games they enjoy. It's not clear that all participants do freeplay games, and it seems that at least some of those who do see it as dependent on the amount of free time or energy they have.

- Just Bob and Kevin mentioned study guides, and neither uses them consistently nor with much apparent passion, but more as a curiosity or time-killer.

Participants motivations varied, and the one participant who did not spontaneously offer some concrete personal goal (tied to EPQ/difficulty or otherwise) at any point in the session is also the one who reported the significant lapse in app usage. This and other evidence (much of it in the quotations below) suggests that people with motivations outside the app are our primary persona for product-market fit at present.

- Bob: "For me, I don't want [the app to congratulate me — which it does not, much]. You thinking I did wonderful is irrelevant to me." and "There are two types of people — [those who like to] keep score vs. [those who see their time in the app as a] direct extension of their imaginations." He puts himself in the latter camp, but does note his percentile rank in various categories more than once during the session.

- Brian: "Really hurts when I miss that streak. It's most akin to working out." And: "It helps to make my day structured. [Anything else you do to make that structure happen?] Working out is one. Having something for breakfast. Everyone around the globe is doing right now — adjustments are being made. [And that's] important, because there are other ways I need to be more flexible." And "If I have time, if I remember, if I don't do as well as I would like to do on a particular game, come in in the top 10 instead of the top 5, [you get three tries], I may challenge myself to get either the top score or the top 5."

- Courtney: "I gotta tell you, I had this 67-day streak and I had the surgery, and I haven't gotten on since because it makes me so mad. ... I love looking at the

rankings [and EPQ], because I'm pretty awesome." And: "I like to be moving forward and I see that speaking is slightly lower than the other ones, and I might go back in there. I would go into activities, and I would go to public speaking, and just kinda play around and do some games. I would probably have a couple of targeted days."

- Melissa: Asked about EPQ, Melissa hesitated and then replied "Not sure what you're talking about." Game difficulty, similarly, was something she said she does not "pay much attention to." Her motivations are just to improve, and none of the in-app motivational constructs seem to have taken hold for her. (She's also the participant who seems to have lapsed most in her usage, it is worth noting.)

- Kevin: "I use Instagram a lot [for business]. When I had the streak, I would do a snapshot [on Instagram]. The adjective one — I perform really high on it, so I'll take a video [and post it on Instagram]." And: "I saw my percentages pop up and wanted to make sure my percentages were higher for speaking, writing, math. ... Then ones I really start enjoying, the adjective one the memory one, those I would try to max out. ... As time went on," Kevin reports, he'd compare his numbers to other users in his age group, trying to keep rankings for each category the same.

- Mariejean has a bespoke goal of shooting for as many excellent games as she can

- Sharon likewise shoots for high scores in many games

All participants have a routine during which they use Elevate; some of these are triggered by the daily reminder notification but the more powerful habituation device is likely simple pairing with an external part of a daily routine.

- Bob: "In the morning, I have a routine that I started with therapy. But now, I just use it as a way to clear my head and have some challenging activities, part of that 'Have a cup of coffee in the morning' [routine]."

- Brian: Does the daily session "every day, usually in the morning, between 6 and 9, usually one of the first things I do when I wake up in the morning. ... It's helpful, part of my routine. I enjoy it. It helps me wake up in the morning."

- Courtney: "I'm a night owl, so I would do it at midnight every night when the next day's [session] came out. [I'd] just do those five and [not] get back to it." About half the time, it's the last thing she does before bed.

- Melissa: "The timer is set for 9am, and I think when I started [using the app], that was when I was recovering from surgery, so that was a good time of day. I was woken up good, had my coffee." (It's less of a good time now that she's back to work.)

- "Right now I've been using it a little bit less because there's a whole lot I have to get done for the business. Before, I would usually do the daily session right after midnight."

The app has enough variety in games and content to be able to serve different people in different ways.

- Bob: "There are so many studies that point to, if you're trying to hold back the sands of time, most of these activities are occupying your time, not really doing anything. I got into Elevate at a time when I could see it doing something." And: "One of the things that's interesting is that when you get to the higher level of some of these things, it's rewarding to see that there's increased variety. For example there's one game that you start off and then you can do vocabulary — three versions (here's the word, which of the three words on the bottom defines the first word better). Then, you get to the point where you get four choices in the bottom. You're using more than just your knowledge, you're using [different, more] complex skills that allow you to find the answer. ... It's not just the literal task [that the game is targeting] but it evolves across — combines different skills."

- Brian: "I really like the word games, the language games. Most recently, pronunciation is one I got into. Those were always my strengths in grade school. Anything that allows me to be reminded that I speak eloquently, that I can spell pretty well. It brings me joy." Also: "If I know I've already played that game [recently], and I got like an excellent score, I'll skip that game [and play something I need to improve more]. Do I love it? No... [but it's the right way]."

- Courtney: "Language is my comfort zone so I really enjoy leveling up higher. ... I've gotten to a point where, the words — I really have to think. Alright, what is lugubrious?" And: "I love it, I love the variety, I love the mechanics."

- Melissa, who is working on recovering from the cognitive effects of chemotherapy, notes, "I do think it helps." She discusses current favorite games as those that are helping her improve: "Oh, that adjective recall... I'm glad to see it come up, because I'm like oh, I need to work on that. And for some reason I'm having problems with subtraction lately. There is the one where you pick the fill-in-the-blank, and it's the diamonds behind it if you get it right — I like that one a lot. Also grammar ones — helps get better with written communications."

- Kevin says " I know it's going to strengthen my mind" and that "[e]verything I use the app for automatically applies to what I'm doing" (public speaking and life-coaching).

- Marijean, Sharon and Brian mention listening games among their favorite games (including Name Recall, Sequencing, and Retention). Interesting to note that these are the only three users of our bunch that have accounts old enough to qualify to have Listening games.

The app seems to be perceived as more interesting than fun, in part because sometimes the harder challenges for an individual participant are not enjoyable, and in part because the games are so heavily focused on instruction and learning.

- Bob: "For me to maintain interest in this for six or eight months... that's a lot." And: "You take a one-a-day vitamin. In the grand scheme of things, it's not going to save your life, but you feel better doing it than not. Especially, you get to a certain point and you look at little, infinitesimal growth [of EPQ]."

- Brian notes, "There are a few games I enjoy, that I kind of hope will come up," implying that the rest, he does not enjoy (reinforced later). He also notes some unpleasantness early on: "In the beginning — I guess no one likes to be told [they have deficiencies]. ... Now, as I'm older, challenge met. Bring it on." Finally, he discusses the ways that less-interesting games can feel by analogy with his childhood (and his 10-year-old daughter's experiences in school today): "When I was a kid, if it was something that I was less interested in, that was more of a chore and a challenge."

- Courtney notes, "When I get a high score, I'm like, OK great. If I don't get one, the ones that make me rage are the ones where you don't even pass and then you have to do it over again." She also says, "I get why there is that variety, but Ugh, two maths tonight, alright. ... If there was a category, and you could have two overrides per day — just take me out of averages [but put me in another math]." However, she also notes that she's glad the app covers both words and numbers. Courtney also mentioned she describes the app to others as "a game-based way to improve your language and math skills." Admittedly, what made Courtney decide to pay in the first place: "It was really fun."

- Melissa: "At first, it was kind of like, oh yay, this is gonna help. And I do believe it helps. But now I'm like, oh, how challenging..." (It can be too hard). Also: "I wish sometimes they were a little more fun. That is what I kind of like about Lumosity. It seems to be more — Elevate's more challenging in a lot of different ways. [...] I can tell it's still making me think, but it just seems more relaxed. It's more like a game."

Content repetition did not emerge as a major problem, with three participants mentioning it, and only one as an issue.

- Brian: "Some games appear to be more frequently revisited, updated, than others. I get notices about [content updates], and [they] just seem to repeat a lot of the same stories over and over. And sometimes I can get really bored with that. And there's another one, Processing. It seems like the same stories, the same words. There are a couple I really like, like sharks. Love sharks. ... Other than that, it's a little frustrating when it's the same thing over, and over, and it's not something I'm interested in. ... Maybe [let] me choose some of the topics, like maybe asking me, 'What are some of your favorite topics?' — like sharks, maybe dinosaurs, maybe African-American history ... to give

me more control to incentivize me to play this more routinely than I do. ... I think that happens with punctuation. Some of the facts have been repeated over and over again, but they're helpful, they're interesting."

- Courtney: "It's kind of fun for me, because I love words so much. [Thinking of "lugubrious":] I know I've seen that a lot. Why have I seen that and I still don't know it? And then when I don't know that, I have to learn that."

- Kevin: "There are certain ones that I'll play, like adjective recall, and I'll have a word that's in my head that I'm starting to remember, and if I play it three times and leave, [i lose the word]. Would be more motivation with more repetition"

The feedback the app gives around a user's domain knowledge was spontaneously mentioned as valuable to several participants, but not mentioned by the others.

- Courtney: "I love, love, love the feedback. If it's a word that I didn't know the definition [of], I love that I can read about that, stick that in my head, and [carry it forward]. If the feedback weren't there, I don't think I would have [subscribed]."

- Melissa: "Lots of days I do leave the reminder up on my phone. I know it lets me go back and look at my mistakes, I'm not very good about that" (but she wants to be).

- Kevin: "For the adjective [game], I might give 10 different quick answers, and then I'll see the other options I could have used. And then the next time I'll try to put the others in the app." And "[Sometimes] people might use words and not even know if it's the right word. And somehow we're using it and we're just right, but we don't know why. [With Elevate], you can see the exact meaning."

Users frequently grouped the games into language and math games in spite of the 3 separate categories of the non-Listening language games - Reading/Writing/Speaking.

- Courtney: "A game-based way to improve language and math skills".

- Brian divided them into word/language games and math games throughout.

- Sharon mentioned the variety between the "math games and the language games and the punctuation games". Much of the interview she contrasts her ease with language versus her difficulty with math.

- Marijean talks about writing/grammar games versus math games (also mentions Listening since she has these).

- John talks about math games as a category - the language game he talks about with ad hoc categories like "usage", "punctuation", "speed reading".

B First Impressions unmoderated usability study tasks

B.1 Interview plan

The following set of tasks has been used in the unmoderated usability study with new users, which aimed at identifying the user's experiences and impressions of Elevate on their first day.

- **Task 1: Install Elevate** - Screens: App Store listing for Elevate.
  - Imagine you are looking for a new app to help you keep your mind sharp. You hear about this app, Elevate, from an ad, and land on this app store page. Before you install it, take a look at the app store page and tell us what you see. What do you think Elevate does?
  - Go ahead and download Elevate, then open up the app.
- **Task 2: Sign up for an account** - Screens: initial onboarding pitch, training goals, onboarding test, EPQ reveal, registration.
  - Once you've opened Elevate, proceed through the screens you're shown. Your first task is to finish a short intro test. You'll know you're finished with the test when you see a screen with a check-mark and "Thank you". Please tell us what's happening along the way.
  - What did you think of the test? What do you think the purpose of it is?
  - If you haven't already, move on the screen that says "Your starting EPQ". What do you think of your results?
  - Has anything changed in what you think Elevate does, compared to when you first installed the app?
  - Your next task is to sign up for an Elevate account with your email address (a fake one is fine if you'd rather not share your real one). Move on to the next task once you have signed up and see a screen that says "Unlock Elevate".
  - Is there anything confusing or unexpected so far? Any step that felt unnecessary?
- **Task 3: Paywall** - Screens: post-registration up-sell
  - Your task on this "Unlock Elevate" screen is to answer the question, "What am I being offered and what are my options?" Once you feel you have addressed this question, continue to the next task without taking any action on this screen yet.
  - Did you notice the X in the top left corner? If you haven't already mentioned this, what do you think it does?

  - Click the X in the top-left corner—this will allow you to continue to use Elevate without starting a trial. Then, move on to the next task.

- **Task 4: Start training session and finish first game** - Screens: training reminders screen (iOS), training session begins, games pre-roll, game play, post-game.
  - Now that you have created an account, you're ready to start using Elevate. Continue through the app until you finish your first game and get your results for that game. Please tell us what's happening along the way. After you get your game results, move on to the next task.
  - How was the game? How did you do?
  - Tell us about your specific results. What do they mean?
  - What do you think of Elevate so far? Is this what you expected Elevate to be?

- **Task 5: Finishing the session** - Screens: games pre-roll, game play, post-game (for 2nd and 3rd game)
  - Continue your session and keep playing until you finish your training for the day.
  - How were the last two games? How did you do?

- **Task 6: Wrapping up** - Screens: post-session
  - Continue on past the "You have finished your free training" screen. Move on to the next task when you get to the "Session Highlights" screen. Take note of what you see along the way.
  - You have finished your session! How do you feel? Is this what you expected Elevate would be? Tell us more.
  - What was the highlight of the experience, something you remember the most? Tell us about it.
  - What was the most confusing or unexpected thing about the experience? Do you have any big questions about Elevate at this point?

- **Written questionnaire**
  - Would you continue using this app? Why or why not?
  - Let's assume you wanted to continue using Elevate. How would you use this app from here
  - <separate prompt>How much do you agree or disagree with the following statement: "I enjoyed my experience using this app"? (0 = Strongly disagree, 5 = Strongly agree)
  - How valuable do you feel Elevate might be if you kept using it? (0 = Not valuable, 5 = Extremely valuable)

B.2 User quotes

Participants experienced both encouragement and discouragement on their first day, driven by challenge, success, and frustration.

- “Did I pass everything. . . ? Yes! Finally!”
- “Elevate is really for someone who is already advanced before they begin”
- ”That was the most frustrating, but it was probably the most entertaining and most fun.”

The top source of avoidable frustration was game mechanics, especially the timer and unclear game tutorials.

- “I struggle with exactly what’s going to happen when the game starts”
- “...I’m not sure what just happened”

The top source of confusion was complex game performance stats.

- “That was not a high score. Lies.”
- ”Did I do well? I’m thinking that I did very good because of the high score, but the 5504, yeah, it doesn’t mean anything to me"

Participants came in with a positive impression of Elevate as a brain training app, but shifted emphasis from “fun” to “meaningful”.

- ”This is not what I was expecting. This is actually better than what I was expecting. I was expecting you to show a bunch of games, but I like how these are like progress reports."

Participants took our claims seriously, and took their performance personally.

- “I had suspected I was maybe a little bit higher than my scores suggest”
- “Wow, Okay. Basic, I’m basic. Alright.”
- ”I thought I was a little bit smarter than I obviously am. I’m actually shocked at myself. I feel like if I was to continue using Elevate, I definitely would be smarter in many more areas.”

C List of requirements for changes to the user onboarding in the Elevate app

Table C1: List of requirements for changes to the user onboarding in Elevate

Requirement	**Objective**	**Stage**	**Motivation Level**
RQ1: Returner-friendly flow	Faster and clearer onboarding pitch flow	Onboarding pitch	Convince and Understand
RQ2: Trial pitch card	Faster and clearer onboarding pitch flow	Onboarding pitch	Convince
RQ3: Sign in with Apple	New SSO options for smoother registration	Sign-up	Invest
RQ4: Google SignIn	New SSO options for smoother registration	Sign-up	Invest
RQ5: Allow an empty first name in sign-up with email	Less friction points for data collection	Sign-up	Invest
RQ6: Remove last name collection from sign-up with email	Less friction points for data collection	Sign-up	Invest
RQ7: Change text for the start trial button	More clarity around free trial and paid version	Up-sell	Invest
RQ8: Add a training streak button in the Training tab	Engagement and fun	First training session	Activate
RQ9: New messages for progress and high scores	Communication about scores and game mechanics	First training session	Educate
RQ10: Easier game completion threshold	Easier day-one gameplay	First training session	Educate
RQ11: Win-back offers	Attract churned users with new onboarding	Re-onboarding	Activate